JULY 1970

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RAILWAY SYSTEM CONTROLS

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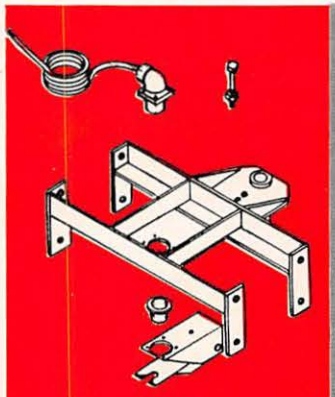

76225
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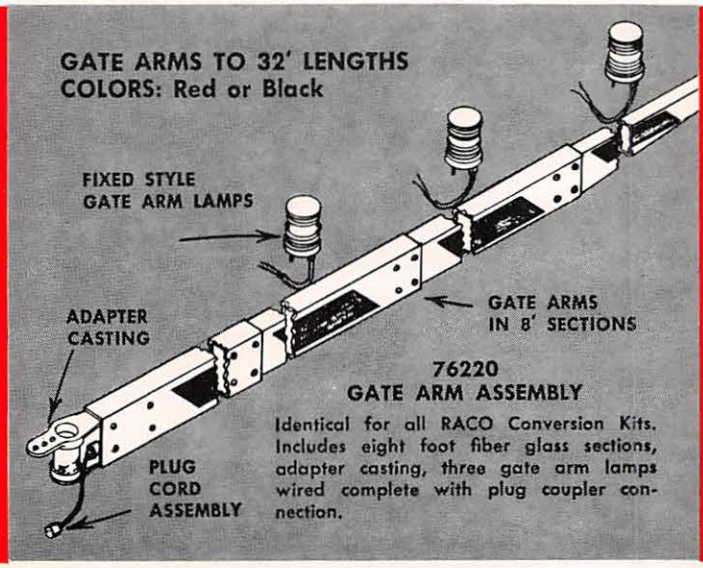
for converting wood arms to fiber glass on all pedestal mounted gates.



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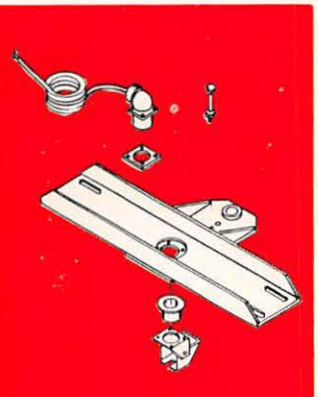

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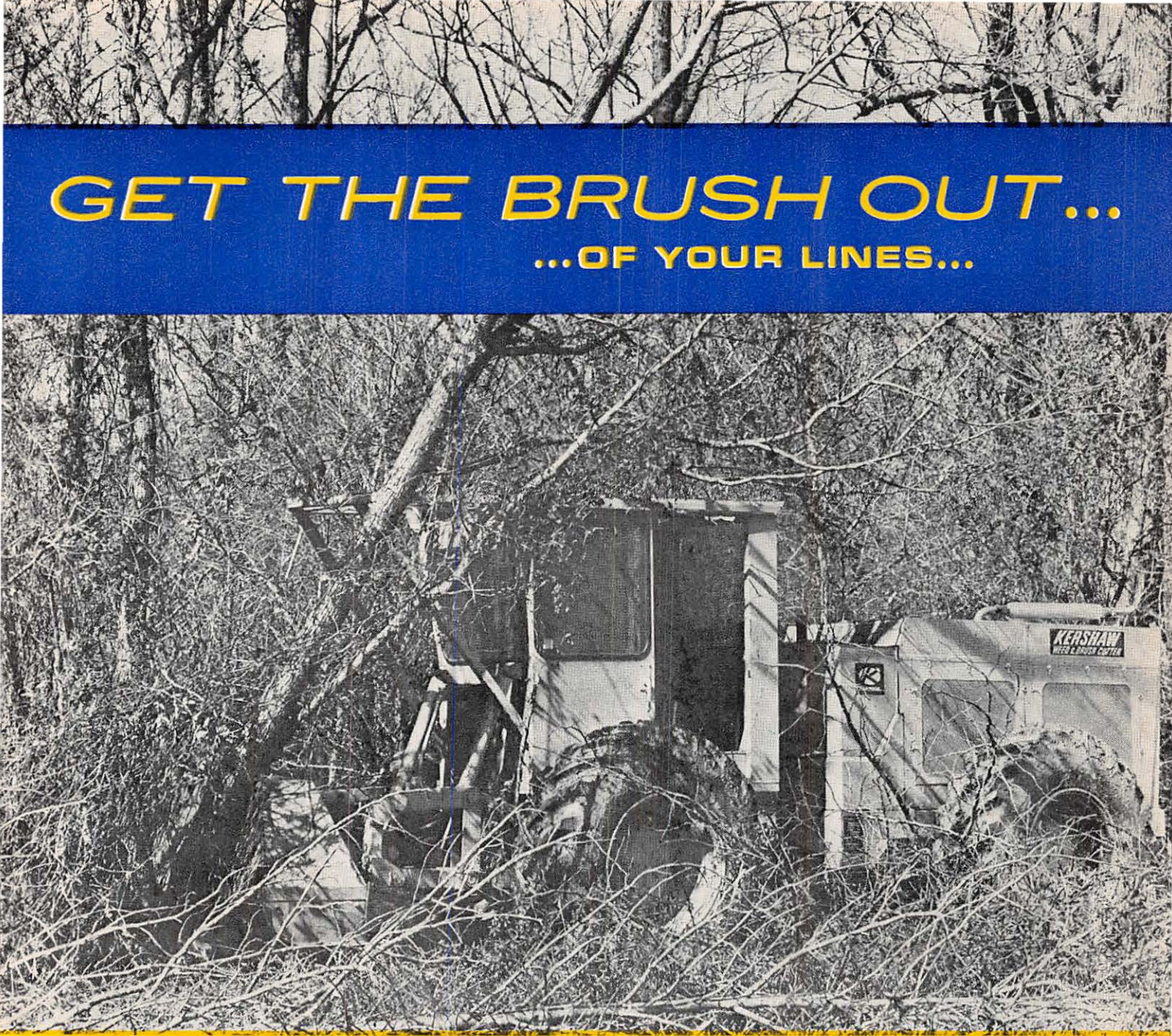

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RSC RAILWAY SYSTEM CONTROLS

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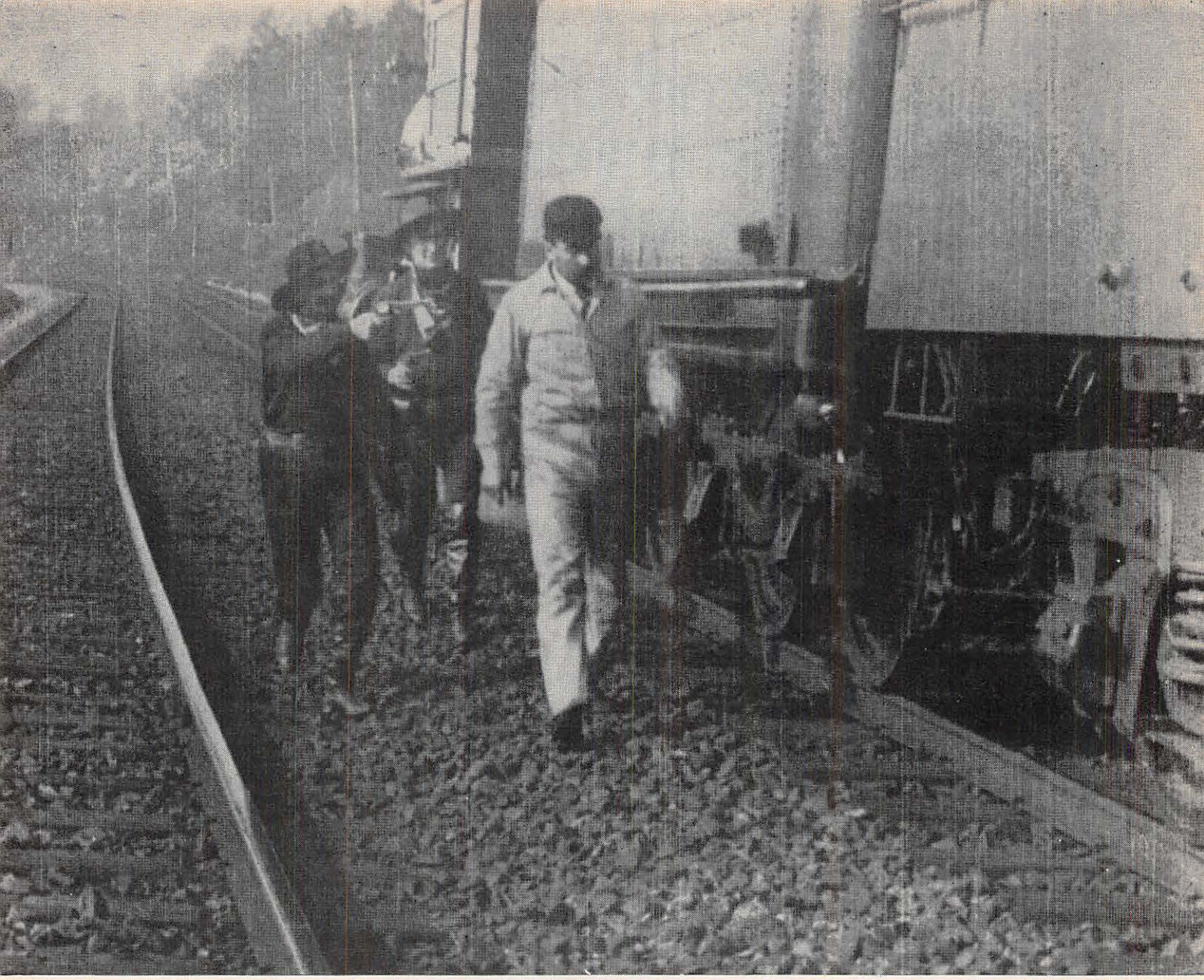

"Never you mind 'bout that new Servo display system you're gettin' next month—right now, start walkin' and don't stop till you find the hot box!"

EVEN without the guns pointed at him, our railroad friend's task of "walking the train" to find a hot journal box was not an enviable one. It certainly would have been simpler and quicker if he did have our new SERVOLARM® Trackside Hot Box Visual Display System.

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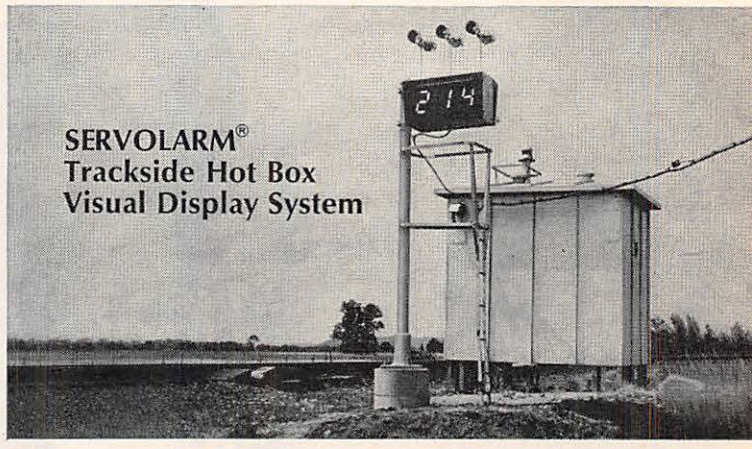

Bi-directional display board presents digital readout, showing axle count location of hot journal box. If no hot boxes are detected, display board reads "000". Flashing signal lamps on top indicate presence of hot box.

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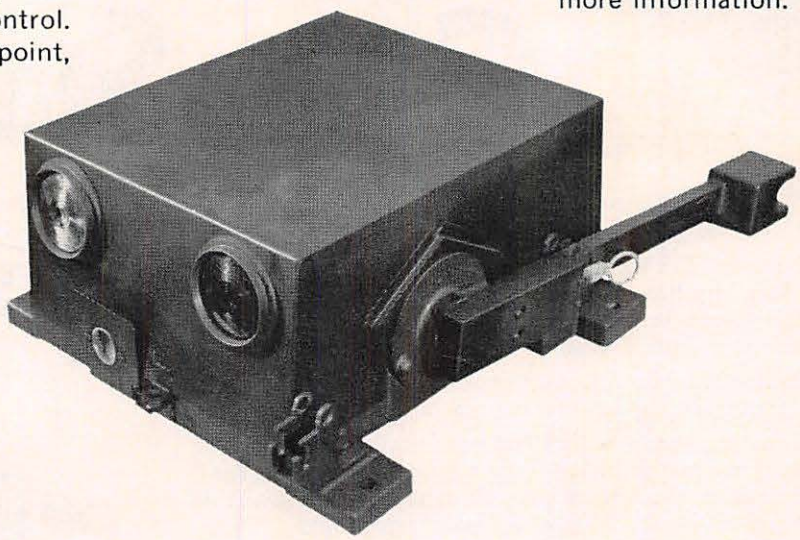

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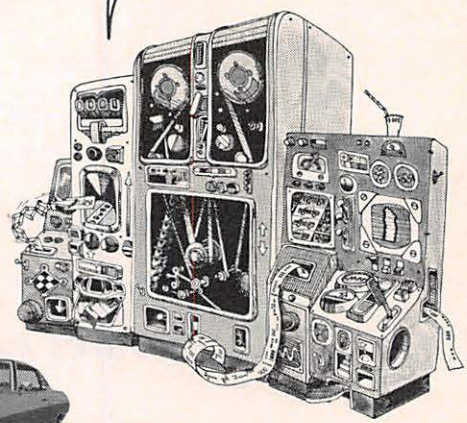

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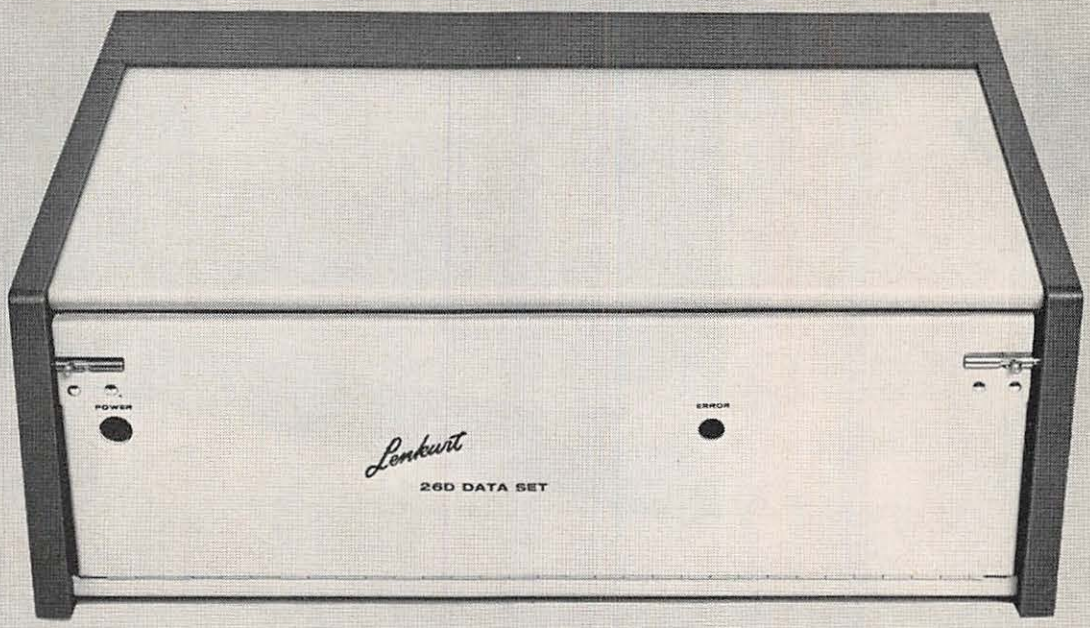

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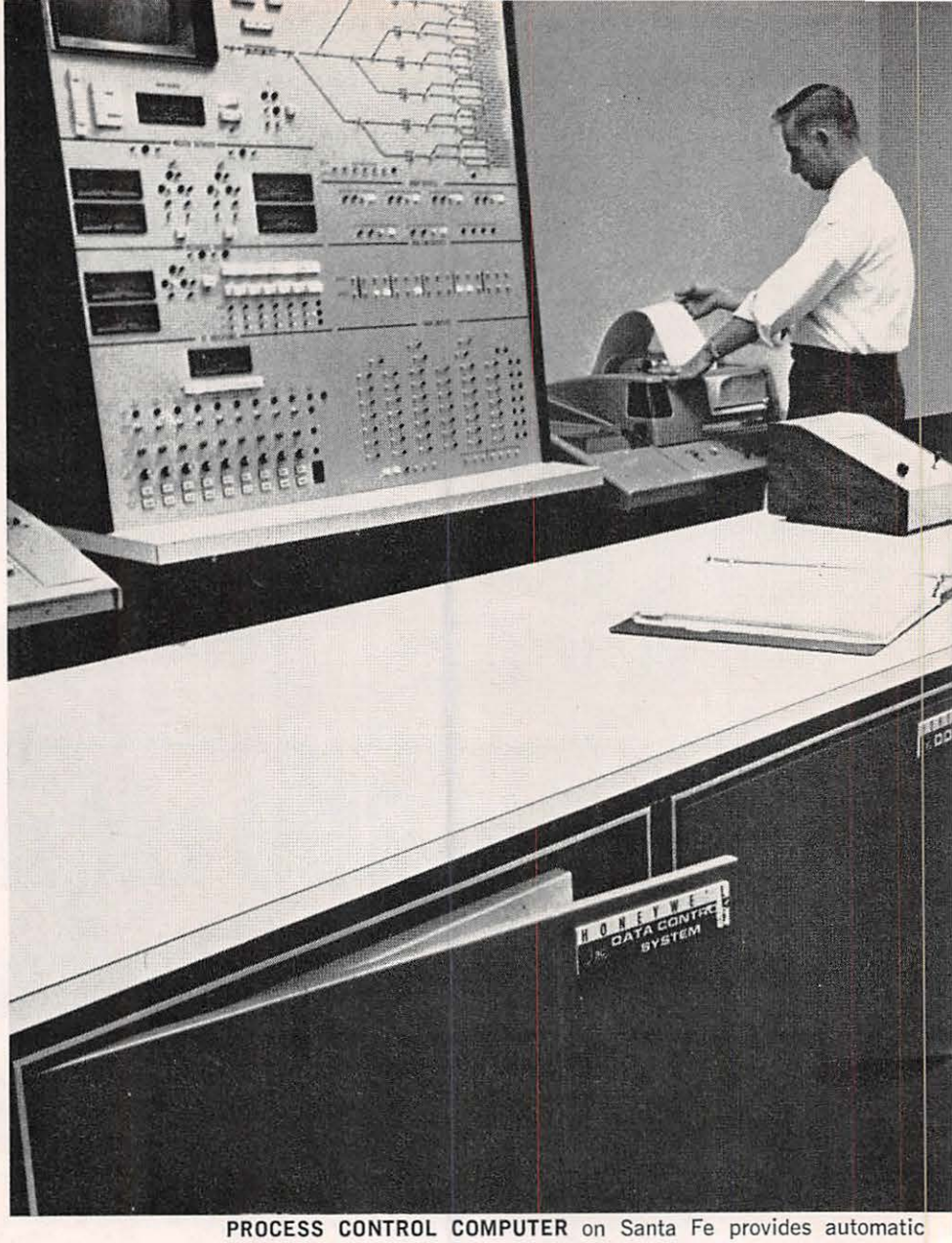


PROCESS CONTROL COMPUTER on Santa Fe provides automatic

Automatic yards have process controls

The process control computer, well known in the chemical, paper-making and petroleum industries, has been accepted by the railroad industry as an important tool for the production control of automatic freight classification yards. Twelve such yards in the U.S. and Canada have process control computers. Of these, two yards are under construction, while two others are being modernized by the installation of process control computers.

A new eastbound, 48-track classification yard was recently opened by the Santa Fe at Argentine, Kan. employing WABCO's total terminal control package including two process control computers.

"The computerized system will result in improvements of approximately 50% in elapsed time of cars moving through the yard, assist Santa Fe personnel to produce improved operations, and achieve gentler handling of shipments routed via Santa Fe. It will mean important service benefits to our customers in all parts of the country," said John S. Reed, president AT&SF, at the official opening on May 13.

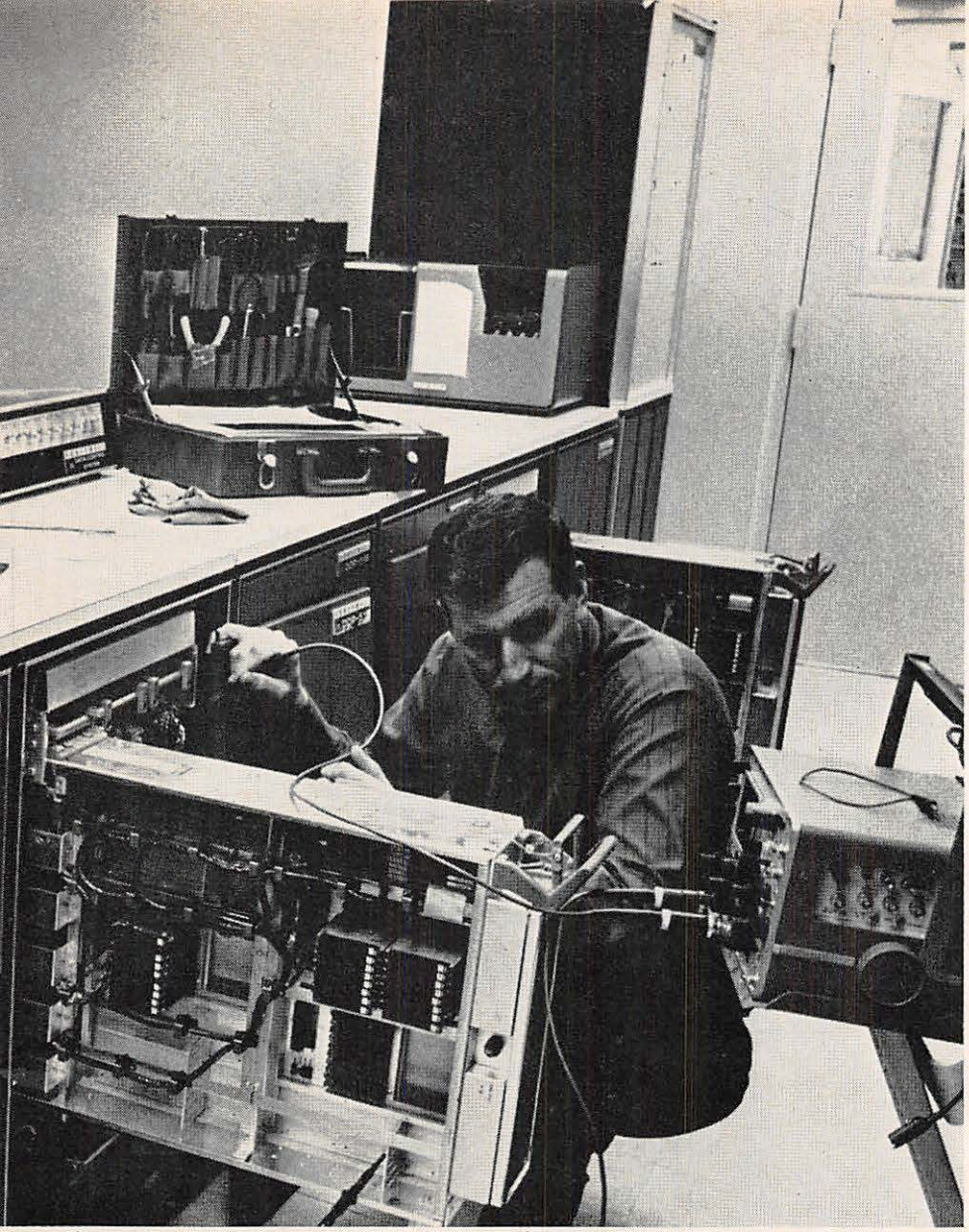
This $12 million facility is equipped with dual Honeywell DDP-516 process control computers. These units handle automatic routing of cars, speed control and car inventory in the classification yard, as well as operational reports and statistics.

The main data processing function in connection with the yard is performed by an IBM model 360/30 computer located in the terminal superintendent's office building. This computer handles data for both the new eastbound automatic hump yard and the older westbound manual hump yard. Preparation of wheel reports and various other reports required for control of car inventory are handled in this computer which, in turn, is connected to an IBM 360/65 computer at Topeka, Kan. by means of a 1200-baud communications data channel.

The 360/65 at Topeka is the master computer for car inventory, as well as the switching of both communications and data. This computer is fed information covering car location and train movement from key points over the entire railroad.

The list that is used in humping the cars in the new yard is transmitted from the 360/30 computer (terminal superintendent's office building) to the DDP-516 computer located at the hump crest by means of a 1200-baud communications data channel. The 360/30 unit has connected to it input/output 35-KSR Teletypes located in the offices of the trainmaster, bowl yard master, and hump yardmaster. Also, the hump yardmaster has a 35-RO Teletype on which he receives inbound and outbound wheel reports.

Each DDP-516 computer has a 35-ASR printer connected to it for maintenance purposes. There is also a video tube display, common to both units, which is used for maintenance. There are input/output 35-KSR printers in the offices of the hump yardmaster, bowl yardmaster and the superintendent's bill office. A fall-back facility,



routing and car speed controls as well as car inventory functions.

MANAGEMENT INFORMATION

Railroads are finding it to their advantage to combine the attractive features of analog and digital computers in providing control systems for automatic classification yards. Monitoring of sensing devices is essentially an analog function. Yet process of information or data represented by or received from sensing devices is essentially a digital process. Combinations of the two basic types of processing is now available in process control computer. Twelve automatic classification yards have such computers in service, or are undergoing the installation of such computers.

Santa Fe has chosen for its Argentine, Kan. yard two process control computers for yard controls. The major paperwork function, such as preparing switch lists and train consist or wheel reports, is handled by a business digital computer. Other roads, however, use their yard process control computers to handle all paperwork functions.

consisting of a 35-ASR printer and an IBM 029 card reader-punch, connected by means of a translator is installed in the bill office so that in the event of failure of the 360/30 computer a deck of cards can be transmitted to the DDP-516 computers to provide continuity of operation.

The Honeywell DDP-516 computers are each provided with a separate disc storage unit and separate interfaces to all I/O units and the field control equipment. Both computers are on line at all times in the receive mode; however, only one computer is connected to the output facilities. In the event of failure of the master computer, the hump yardmaster and maintenance personnel are alarmed. The hump yardmaster operates the switch which transfers the output circuits from the master to the standby computer. This standby computer has all the same information as the master and, therefore, is able to continue the operation of the yard.

The yard control functions of the system are those which physically control the classification of cars. These functions include automatic switching, speed control of cars and control of the hump conductor's CRT display unit providing line sequence number, car initial and number, and track destinations for the maximum of 12 cars from the hump list, representing the next 12 cars, in order, to be shoved over the crest. Inputs from the hump conductor's console are used to alter track destination for the car represented by the top line on the CRT display. Manual input is provided for clearing the CRT display.

The process control computers also receive and process information from the automatic car identification scanning equipment (to be installed) and the in-motion weighing scale for use by the system. They detect equipment malfunctions, unsafe conditions, and other circumstances which require alarm indications or various types of operational reports. These control computers communicate with the information handling portion of the system as required by operating conditions.

The information handling functions of the system are those functions connected with processing inventory data and generating reports of various types. Also associated with this are functions which control the operation of the system. These functions include:

(1) Bowl yard inventory—Maintain complete inventory records for all cars on the bowl tracks, with typewriter commands provided to modify inventory, request logs and track reports, and punch a deck of cards showing inventory data.

(2) Hump lists—Maintain hump list containing inventory data and assigned track destinations for cars to be humped and create "as-humped" list reflecting the status of cars that have been humped.

(3) Input hump lists and output "as-humped" lists either through a data link to the 360/30 computer or to the 35-029 printer and card reader-punch.

(4) Coordinate the actions of the two processing units, to insure that

the standby processor has the proper back-up inventory data at all times.

(5) Control I/O devices—Process typewriter input commands; generate typewriter output messages; control card reading and punching; control the use of the disc storage units and video display devices.

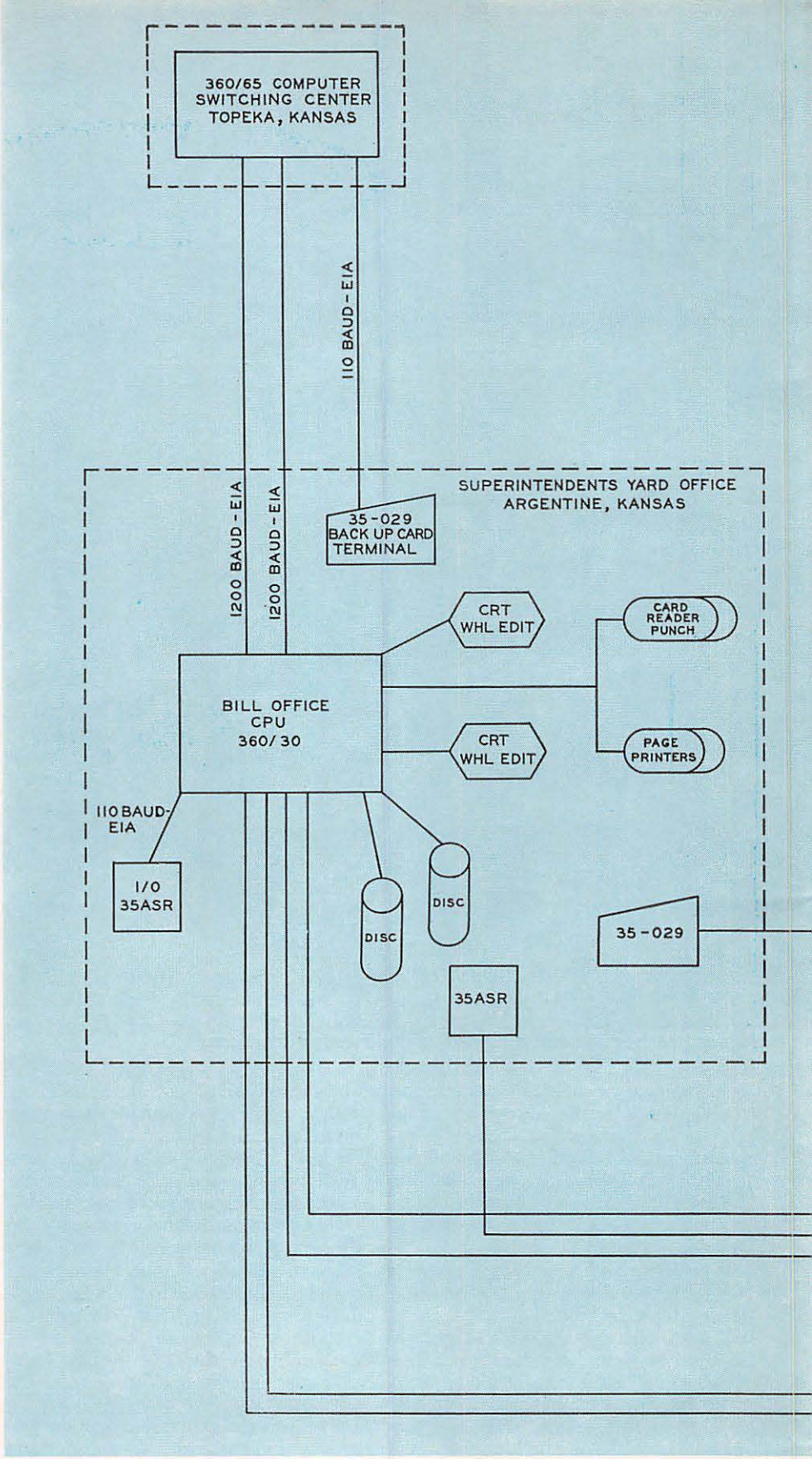
(6) Communicate with the 360/30 computer in the terminal superintendent's office building.

Operation of the computers in processing a train through the yard is described by L. Ralph Thomas, general superintendent communications and signals, AT&SF. The process begins at Topeka, says Thomas. Here is an IBM duplexed 360/65 teleprocessing computer system which gathers from every point on the Santa Fe data reporting freight cars interchanged between railroads, reports of cars loaded or unloaded, and all train manifests. A train manifest addressed to Argentine is received, edited and, if necessary, corrected and transmitted to the 360/30 data processing computer at Argentine. The means of communications between these two computers is by way of a binary synchronous communications circuit transmitted at the rate of 1200 bits per second.

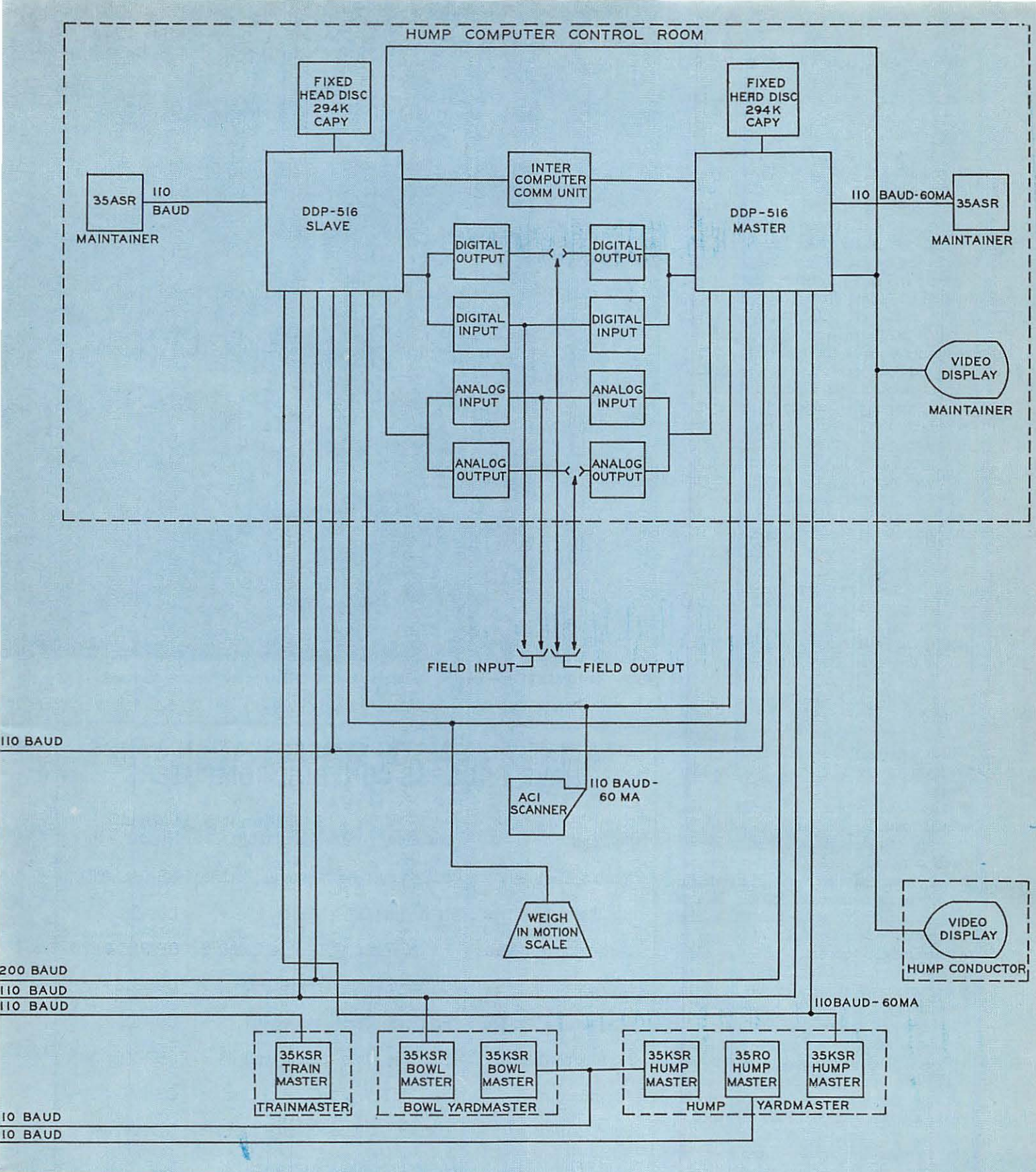
When the mainfest is received, the 360/30 program recognizes cars destined for connecting lines and proper blocking of the train for eastbound movement over the Santa Fe, and prepares the hump list indicating the routing of the cars to the appropriate classification tracks. Each hump list is prefaced with a train header-card which contains train identification, date, time, report number, hump list number and the number of the receiving yard track where the cut of cars to be humped is located. The data cards following the hump header-card contain for each car information necessary to appropriately route the car, such as on-line destination, identity of the road to which the car is to be delivered and the designated track within the classification yard to which the car should be routed.

The yardmaster, being advised of the arrival time of the train, routes it into the yard on the specified track and notifies the car inspectors the receiving track number. The car inspectors arrange for blue flagging light signals to be turned on at each end of the track after the train is in the yard, thus taking the track out of service. Mechanical department forces make an inbound inspection, exhaust the air from the brake system on the cars, and make minor repairs. The blue flag signals are cleared and the train is released for humping.

In the meantime, the hump yardmaster has issued a command to the 360/30 computer to transmit a hump list for the particular cut of cars he is preparing to hump. The 360/30 then transmits the list to the process control computer (DDP-516) located at the hump, which has sufficient memory to store four 150-car lists. He now directs one of the hump engines by radio to pick up the train or cut to be humped, and lines the appropriate route for the pull back movement to the hump lead. After this movement is completed and the crest lead is clear and ready for humping, he sets the hump signal to display Hump Slow. He also remotely sets the cab signal controlling the hump locomotive to



SANTA FE ARGENTINE YARD CONTROLS use two Honeywell DDP-516



process control computers that are linked via 1200 and 110 baud communications channels to IBM 360/30, also at yard.

Hump Slow. After the locomotive engineer has started the forward movement, the hump yardmaster directs him to place the locomotive in Automatic, after which the hump yardmaster takes control by means of the radio link and sets the speed at any one of seven speeds between 1.0 and 3.0 mph. In the event of an emergency, the hump yardmaster or hump conductor can change the cab signals to Stop, which action will apply the locomotive brakes. The locomotive engineer can also stop his locomotive at any time.

An automatic car identification scanner to be installed on the ascending side of the hump will read the label as attached to the side of each car and transmit car initial and number to the DDP-516 process control computer for comparison with the hump list. Any discrepancies are displayed on a video device (CRT) located in the hump conductor's office. The conductor checks

this display against the printed copy he has before him; all errors are corrected or the conductor can direct the car to a hold track.

Approaching the hump crest, the cars pass over dragging equipment and broken flange detectors which set the hump signal to Stop and alarm both the hump yardmaster and the hump conductor when defects are detected. As the cars move down the hump, the weigh rail establishes the weight classification and radar measures both speed and acceleration, establishing the rollability of the car. Occupancy of each track is continually monitored and the computer equates the rollability against the grade and curvature of the respective tracks, as well as the distance to go to coupling, computing the speed at which the car should be released from the group retarder to limit coupling speed to 4 mph and sets retarder controls accordingly. Inert, weight-activated retarders on each classification track keep the cars from rolling out the bowl end of the class yard.

The hump computer maintains an inventory of cars as classified into each track, which inventory is available to the hump yardmaster, bowl yardmaster or terminal data center (360/30 computer) upon request. When the last car of the train being humped entered the bowl yard track to which it is assigned, the DDP-516 process control computer automatically transmits the "as-humped" list to 360/30 computer which now establishes and maintains an inventory of all cars on classification tracks.

The "as-humped" list includes the actual scaled gross weight which is now an element of data pertaining to each car and is obtained by the car having passed over the automatic weigh-in motion scale on the hump. The data from the scale was fed to the computer. When the 360/30 computer acknowledges receipt of the "as-humped" list, the DDP-516 hump computer automatically erases this list from its memory.

The bowl yardmaster is now ready to assemble the outbound train. He initiates a request message on his 35-KSR Teletype to the hump computer for the inventory of the class tracks that will be pulled. This is printed out on the same 35-KSR on which the request was made. From this information he determines what cars he will pull from each track and the sequence in which the cuts from the different tracks will be doubled together and pulled into the departure yard. The number of each track to be pulled is given to the clerk in the terminal data center by intercom or telephone.

The clerk inputs this information into the 360/30 computer which transfers the inventory from its classification

HUMP YARDMASTER compares switch list with CRT display of cars humped.

TWELVE AUTOMATIC CLASSIFICATION YARDS HAVE PROCESS-CONTROL COMPUTERS

Railroad	Location	Computer Manufacturer	Computer Model
Alton & Southern	E. St. Louis, Ill.	General Electric	GE/PAC 4000
Burlington Northern	N. Kansas City*	Honeywell	DDP-516
Burlington Northern	Pasco, Wash.+	General Electric	GE/PAC 4020
CP Rail	Calgary, Alta.*	Honeywell	DDP-516
Missouri Pacific-T&P	Ft. Worth, Tex.+	Honeywell	DDP-516
Norfolk & Western	Bellevue, Ohio	Honeywell	DDP-516
Penn Central	Selkirk, N.Y.	General Electric	GE/PAC 4020
Penn Central	Columbus, Ohio	General Electric	GE/PAC 4020
Santa Fe	Argentine, Kan.	Honeywell	DDP-516
Southern Pacific	Eugene, Ore.	Honeywell	DDP-516
Southern Pacific	Houston, Tex.	IBM	1800
Union Pacific	N. Platte, Neb.	IBM	1800

Note: *Yards under construction
+Yards modernized with P-CC

PROCESS CONTROL HAS ANALOG AND DIGITAL I/O UNITS

yard section. Appropriate header information is attached by the 360/30 computer and additional information is inserted into the data lines indicating station from and station to, completing the preparation of a train manifest which is now ready to be transmitted to the teleprocessing computer in Topeka. Upon receipt, this computer again edits the information and updates the live car file, which is available for inquiry by all Teletype stations on the Santa Fe and available to customers through Western Union Telex. Also, the wheel report on this train is transmitted from Topeka to appropriate offices. Back at Argentine, the terminal data center computer (360/30) instructs the DDP-516 hump computer to delete the cars pulled from the bowl yard from its inventory. In doing this, the hump computer erases the last record it has of these cars, Thomas said.

Prior to the use of process control computers in automatic classification yards, analog computers were used to provide automatic routing of cars to class tracks and for automatic control of retarders. Although some computer experts are of the opinion that the analog computer provides a finer or more precise degree of control than the digital computer for class yards, for example, the digital computer has advantages that make it attractive for process control.

The digital computer can provide car inventory records and do other paperwork that cannot be handled on an analog computer. Also, when physical changes are made in the class yard, reprogramming is usually the only change required for the digital computer. To make changes with an analog type computer in control, usually wiring and component changes will be necessary.

What some call the best of the two types of computers is the process control computer. It is basically a digital device, but is equipped with analog-digital conversion equipment. This permits it to accept analog signals, convert them to digital form, process them and convert the processed data to analog form to provide controls for field equipment. Being a digital device, the process control computer can handle the paper work function in an automatic classification yard.

The major differences between a process computer and a business digital computer are the peripherals, or I/O devices, the interrupt structure and the operating system. In a business computer, input/output is primarily through record-type devices such as punched card equipment, paper and magnetic tape units, or magnetic disc and drum. A program is placed in the computer and the records are processed one by one. Then a different program can be inserted and other data processed. A program is in control of the computer until it has no more work to do and returns control to the operating system or the failure of a peripheral device stops the computer. The operating system, a set of routines always in memory for supervising the operation of the computer, is only entered when a functional program so requests.

I/O devices monitor-control

In a process control computer, though record-type devices exist to input programs and operating data, the main I/O devices are oriented toward monitor and control devices. This includes devices for reading gauges and meters, detecting the position of relays or switches, controlling relays and specialized display hardware and specialized sequence controlling. A series of functional programs are loaded into the computer along with information on when, or how often, a program is to run. Control is given to the operating system which inspects its roster of programs; the most important program scheduled to run (the computer has an internal clock) is determined; and control is given to that program. This program continues to operate until one of the following occurs: (1) a predetermined short period of time elapses, say ¼ second; (2) the program finishes its work; (3) the program requests an input or output operation, or (4) an interrupt occurs.

The first condition is the feature which allows the operating system to constantly keep the most important programs operating. If an average instruction takes four-millionths of a second to be executed, 62,500 instructions could be executed in ¼ second. This makes it possible for one or more programs to operate from start to finish in ¼ of a second. When each functional program is entered into the system, it is assigned a priority. Each time the operating system is entered due to the time condition, it searches its list of functional programs for the most important program that must be run. If an alarm program with a high priority has been turned on in the last ¼ second, the operating system can take immediate steps for this program to operate, thereby insuring response to the "real world" with no noticeable delay.

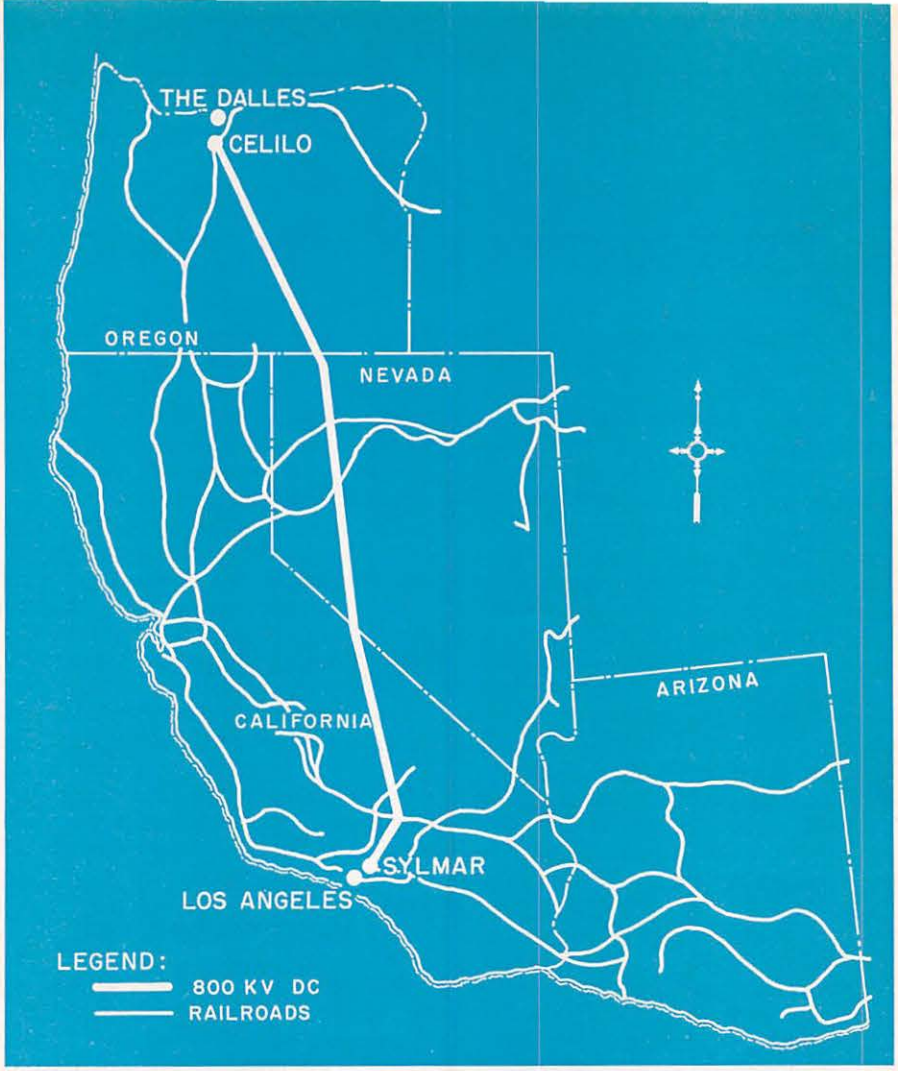
Second, in the process control computer, programs perform tasks such as taking readings, calculating performance values, comparing values to operating limits, and presenting alarms to the operator. Consequently, programs usually do not operate for more than a few instants. When a program finishes its assigned task, it returns control to the operating system to look for the next most important program.

Next, when a program requests an I/O operation, it causes the computer to perform a function thousands of times slower than it normally operates. For example, if a program requested that a number of meter readings be taken and had to wait until they were actually read, a large amount of time would have been wasted in the waiting period which could have been used to execute more than a thousand instructions. Therefore when a program requests an I/O operation, it returns control to the operating system, which allows other programs to operate, until the I/O operation is completed. Each time the operating system is entered due to program completion or I/O request, it resumes searching the program list where it left off.

The last item has to do with alarm response by the computer. Certain conditions in a process normally never change, therefore, it would be wasteful to have a program to determine their position every little while. However, their position might be very important to the process and to plant safety. These functions are monitored through the use of automatic program interrupts, APIs. As soon as one of these "alarms" occur, the computer senses it. The computer then interrupts its present program and turns on the program necessary to handle the alarm condition. This program, as any other functional program, operates until one of the four conditions occur. It should be noted that any time a program is left before completion, its present status can be saved so that computation can be picked up at the same point when that program resumes operations.

MANAGEMENT INFORMATION

Installation of a high-voltage, direct current power transmission line on the west coast of the U.S. may cause trouble for railroad open-wire carrier systems. Preliminary tests indicate that HVDC does interfere with these railroad communications facilities. But, further testing will be carried out.



HVDC TRANSMISSION LINE will haul bulk power, Oregon to Los Angeles.

HVDC power transmission line is

BY HUGH M. ROBERTSON
ASSISTANT TO SUPERINTENDENT COMMUNICATIONS
UNION PACIFIC

High-voltage, direct current transmission of electrical energy and its effects on railroad signal and communications facilities are important today because of new utility systems. Bonneville Power Administration and the Los Angeles Water & Power District have constructed an HVDC transmission line from Celilo, Ore. to Sylmar, Calif., 853 miles.

This line is designed to operate in a bipolar mode at 400,000 volts positive and 400,000 volts negative potential, with a grounded center-tap at each end. Therefore, at either converter station one conductor would be 400,000 volt positive and the other conductor would be 400,000 volt negative in relation to ground. Between the two conductors, the voltage would be 800,000 volts, and the current would be 1800 amp in either conductor. In the event of trouble, or during maintenance work on one conductor, the converters are so arranged that either one will operate in a monopolar mode. In this mode, the entire current of 1800 amp flows through the ground. Also, the converters are arranged so that either end can be transmitting power while the other end is receiving power, permitting power to be "wheeled" either from north to south or from south to north.

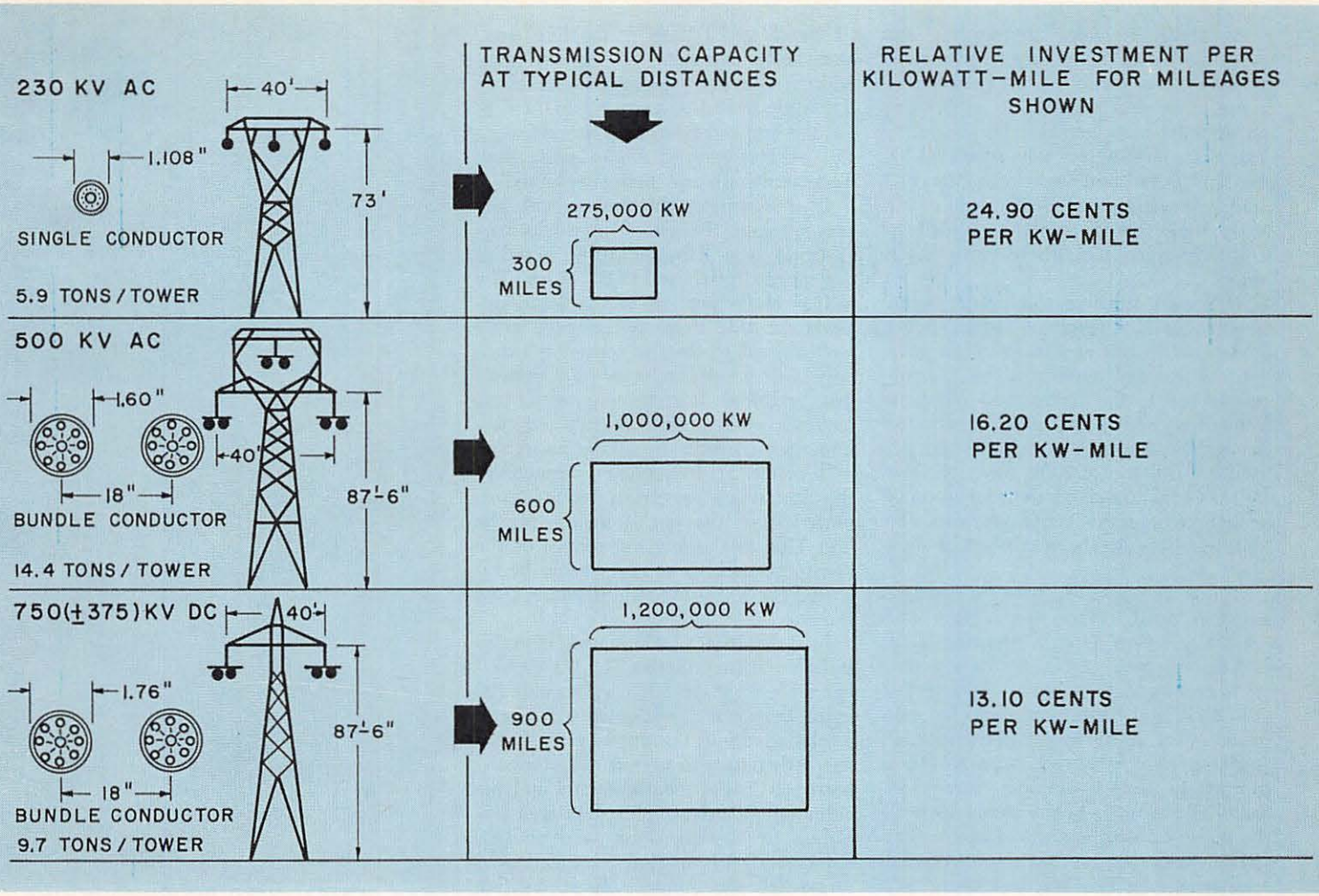
One interesting sidelight is that the potential between conductors and ground at the electrical mid point of the line will be zero even though 1800 amp are flowing through each conductor.

This method of power transmission has many advantages from the standpoint of the power engineer who is expected to transfer great blocks of power from one area to another, as losses due to line reactance are eliminated and synchronization between systems is no longer a problem. There is no question that the use of lines of this type will expand as the power requirements of this country expand and the public continues to resist the construction of fossil fuel and nuclear generating plants in urban areas.

We are already faced in the west with many 500,000 volt AC transmission lines. At a recent meeting of the Institute of Electrical & Electronic Engineers in New York City, it was predicted these voltages would increase to 1,300,000 volts and 10,000 Megawatts.

Two distinct problems result from a high-voltage, direct-current line to railroad facilities, namely inductive and cathodic. Inductive problems are those voltage components generated by the converters in transformation of AC to DC and back again, which by various methods of coupling, result in noise

Editor's note: Paper presented at Sectional Meeting, Communications & Signal Section, AAR, St. Paul, Minn., April 15, 1970.



HIGH-VOLTAGE, DIRECT CURRENT transmission is estimated to cost less when distances are over 500 miles.

ready for service

being impressed on communications or signal facilities. Cathodic problems are those which occur due to ground potential changes resulting from large current flows through the earth.

The two problems, although somewhat related, differ entirely in the application of corrective measures.

Subsequent to a seminar held by the AAR Communication & Signal Section in 1966, two groups were organized to study the various problems associated with this HVDC line. A cathodic group, which included the pipeline organizations, railroads, and communication companies, later employed Ebasco Corp. to coordinate their various test programs and furnish a consolidated report. The other group formed to study the inductive problems was known as the subcommittee on Inductive Coordination Studies. Chairman is George Elder of Los Angeles Water & Power Department.

During May 1969, Los Angeles Water & Power Department held a series of tests utilizing a 5 KW audio tone generator operating between the frequencies of 360 Hz and 5040 Hz. These signals were impressed on the HVDC conductors at a predetermined frequency and voltage for all interested parties to observe in their facilities. At three locations LAWP built test telephone lines 1 km long and 1 km distant and parallel to the HVDC line. As a result of the data obtained from the test lines and the considerable data furnished by the railroads and communications companies, a meeting was held in Los Angeles by the full committee. LAWP and BPA arrived at the conclusion that "discretion was the better part of valor", and agreed to install additional audio filtering in the DC line, as well as filtering in the AC lines supplying the converters. This filtering has now been installed and the line has been energized intermittently since December 1969 for the contractors to optimize the filtering arrangement and properly adjust the firing angles of the converters.

Also, as a result of the audio tests in May 1969, LAWP decided, due to the radio interference emanating from the converters, to install a Faraday screen enclosing the entire converter station, an area of approximately 6 acres.

No screen was installed at the Celilo terminal as Bonneville Power Administration felt that due to the isolated area where the converter is located, it would not be necessary. I am not completely in agreement with this assumption.

During March of this year LAWP and BPA have been performing acceptance tests on the equipment, using various voltages and currents intermittently. The specification for harmonic induction in the audio range was based on a criterion that no interfering signal should result in the three 1-km test lines of over 10 millavolts. Bell Telephone agreed this would be an acceptable limit. The railroad members on this committee are on record, however, of accepting no given limits other than the effects of their own facilities.

During the week of March 30, Union Pacific made a number of tests to determine if we were experiencing interference and several surprising things were developed.

At audio or voice frequencies we were unable to detect any interference; however, we measured an increase in noise of as much as 14 db at the demodulators of several Lenkurt type 33 carriers operating on a line parallel to, but quite far removed from, the DC line. Investigation developed these were tones being directly coupled to the wires on which these carriers operate.

It is very possible this carrier interference is the result of tones being generated in this spectrum by the converters and fed back into the AC primary feed to the converters. We have requested LAWP and PBA to arrange for sufficient testing during the test period by isolating certain areas of their AC network to make a determination of exactly where the coupling exists. To date we have not been advised of their position.

Union Pacific made tests on two line sections April 3. One line is from The Dalles to Rufus, Ore., a distance of 22 miles, on a pair of No. 9 Copperweld, 40% conductivity wires transposed for 150 KHz and having an audio balance in excess of 20 dbrnco. All other carrier systems were removed from this line during the tests to eliminate any possibility of pickup from the adjacent pairs. Increases in level of noise of as much as 30 db were measured at some frequencies when the DC line was energized. These tests were made using a frequency selective VTVM with a 250 cycle bandwidth, the pair terminated in 600 ohms.

The other communication circuit checked extended from Wishram, Wash. to Bend, Ore., a distance of 150 miles. This circuit roughly parallels the HVDC line and crosses under the HVDC line at one point. Approximately the same results were noted on this circuit as the Dalles-Rufus section.

To summarize this interference, it is first measureable at roughly 5 kHz with a very little interference above ambient noise and as the frequency increases, the noise increases up to about 30 kHz where an increase over ambient of almost 30 db was noted. As frequency is further increased, the noise decreases until at 100 kHz it is hardly discernable.

This was brought to the attention of LAWP and a check was made by them on their test sections between 5 kHz and 150 kHz. I do not have their test data, however, I understand they found very noticeable interference.

Unfortunately a great deal of effort was put into the elimination of audio interference but none in that range from 5 kHz to 150 kHZ, and at this time we have no information of the power groups' intentions for its correction.

From May 31-June 7, the line was alternately energized at fixed voltages and currents for the purpose of making harmonic inductive tests. From June 8-11, the line was energized for recording the effects upon cathodic protection. Test results are now being evaluated.

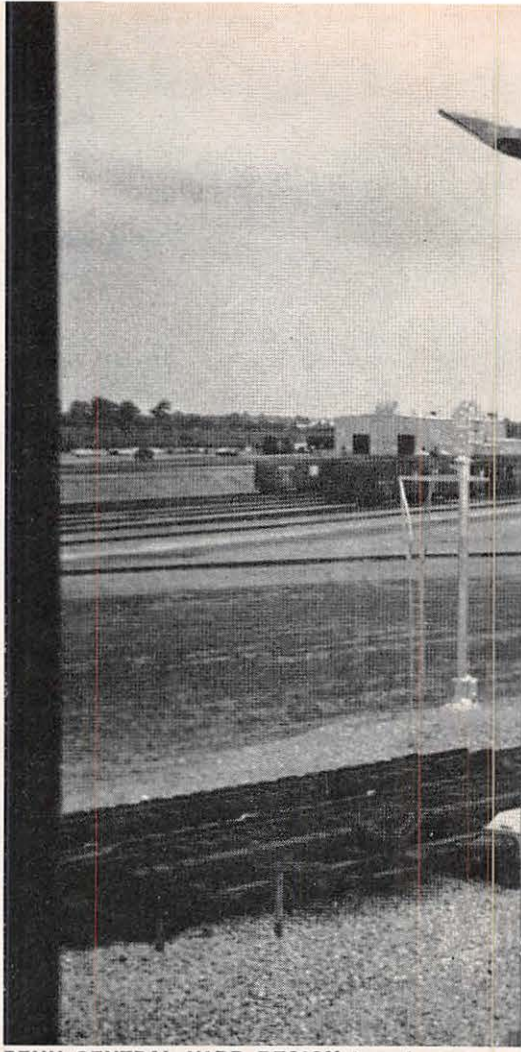
It now appears that unless some action is taken, the use of open-wire carrier systems will be seriously limited in the vicinity of these HVDC lines. The VF or audio portion of the band appears, at this time, to be sufficiently well filtered so that no serious interference will result under normal operating conditions. It must be remembered, however, that any condition on this line which results in a continuing arc will result in frequencies throughout the frequency spectrum being transmitted over the entire length of the line. Due to the low impedance of the line to ground, these tones could be radiated for a considerable distance from the line.

In July 1969, LAWP and BPA installed a test rectifier at The Dalles having an output of 3000 volts and 300 amp. Tests were conducted for several weeks at various current levels utilizing an earth return to permit all interested parties to make measurements and accumulate test data. This data was furnished to Ebasco Corp. who consolidated the information obtained and presented preliminary report in San Francisco early in December to the cathodic subcommittee. They also furnished their recommendations for test locations where data should be obtained during a full scale earth current test period.

The report was quite thorough for the test rectifier period, and a very extensive test area was arranged for the cathodic test period just completed.

General Telephone Company of California has installed half cells at a number of locations in the area of the Sylmar converter station, which they monitor on a continuing basis against their central office ground. Several days ago they advised me, although the present test program does not allow for any appreciable ground current, the center taps of the converters only being grounded to maintain a voltage reference to ground, a fault condition developed in one conductor of the DC line, resulting in the full 1800 amp current flowing to ground for approximately 45 minutes. This fault had a very disastrous effect on the General Telephone Company half cell network.

This brings us up to date on HVDC to this time, naturally the tests, both inductive and cathodic, will produce the answers as to just what effects high-voltage, direct-current operation will have on railroad communication and signal facilities.

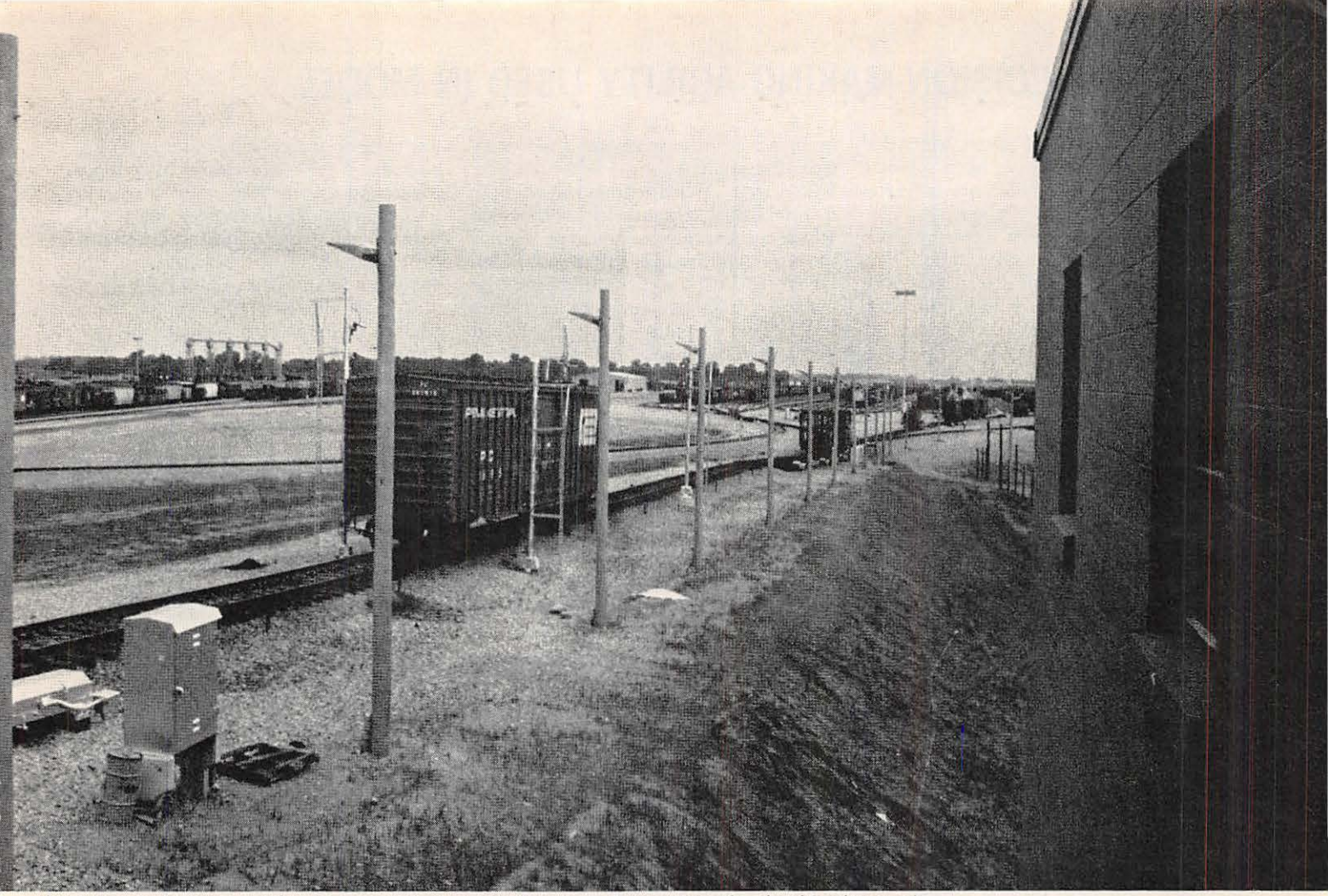


PENN CENTRAL YARD DESIGN based upon

Modeling

Penn Central's new freight yard classification model incorporates human decision-making capabilities. Formerly, some restrictions were used in freight yard computer models which limited the amount of decision-making capability. Relaxing such restrictions enables the model to accurately reflect reality.

"A major by-product of relaxing the restriction is that the new model may be used to evaluate a set of rules for a process controlling computer in a highly automated freight yard. The information requirements for effective management, either by computer or by human being, may be identified with the model. The information used to make decisions in the model is the same information that is required for similar decisions in an actual freight yard," state authors R. H. Mehl and R. C. Shih, senior operations research analysts, Penn Central Transportation Co., in a paper presented at the Third International Symposium on Railway Cybernetics in Tokyo, Japan in April 1970. Essentially full text of the paper follows:



simulation techniques applied to a computer operated model of an automatic classification yard.

via computer aids yard design

The model is written in GPSS. Approximately 1500 program blocks are written. The size of the computing system required depends upon the number of individual trains fed directly into the system. In general, a small or medium sized yard may be simulated on a system using 262K bytes of core, while a large yard requires about 350K bytes of core. The model required about three man-years to complete.

Approximately four user man hours are required to prepare the model for the yard being simulated. The user fills out partially prepared coding forms written in GPSS, although the user writes in only numbers. Approximately eight user man hours are required to prepare a typical set of trains to be processed by the simulated yard. The user does not prepare the train data in GPSS. A FORTRAN preprocessing program reads his data, makes a GPSS translation and punches a GPSS data deck. Once the model is prepared for a given simulation experiment, changes may be made by the user in a matter of as little as a few minutes.

The Penn Central yard model represents technical development in yard simulation in four areas:

(1) The model is general. A user prepared yard descriptive deck permits the model to behave like a specific yard. This approach had been used before, but the burden on the user was great.

(2) The model is flexible. The simulated terminal may have one hump lead, two hump leads, or two separate humps. The terminal may or may not have a departing or advance yard. Partial or full electrification is possible. Trains processed may be entirely humped, partially humped and partially flat-switched, entirely flat-switched, run through with only a crew change, or a combination of the above.

(3) The simulated yard is flexible. Many elements have several uses, and the operation of the yard is given great freedom. No fixed pattern of activities is built into the model. The yard is operated in any of several different ways, depending upon the traffic and the condition of the yard.

(4) The greater flexibility in the yard is controlled by simulated management personnel who make decisions and manage the model yard. A moment's reflection will reveal that the first three departures from traditional approaches, although rigorous, are not difficult. The simulation of human decision-making, however, becomes quite difficult. Approximately two-thirds of the model deals with the creation of decision-making criteria and the development of the various channels of action. Most channels of action are based on many individual criteria. Some of the major areas of decision-making capability are given below.

The model selects an appropriate track for yarding an inbound train. The decision is based on the train's direction, power type, and train type. If possible, the train is yarded on a single track. If no such track exists, the train is yarded on two tracks. No attempt is made to find an optimum yarding track using a rigorous technique. Instead, track selection is made much as a yardmaster would, in that the track which, for the moment, appears the best match

is selected. If, several hours later, the selection appears to have been sub-optimal, neither the model nor a yardmaster can do much about it. The model also must select a receiving yard lead to yard the inbound train. The model attempts to find a lead that will not cause interference with a train that is currently being humped.

If the simulated yard is of the type that has one hump with two hump leads running down it into the classification yard, the model will make a very difficult decision concerning whether to hump one train alone or two trains together, and will then select one or two specific trains. The decision is based largely on the number of cars that would have to be reclassified if two trains were humped together. If two trains are selected, in some cases they must be started simultaneously, while in other cases they need not. The successful operation of an actual yard and a simulated yard with two hump leads is greatly dependent on the selection of trains to be humped.

A major element in the model is the classification yard routine, even though no time advances are involved. Part of this routine is used for the maintenance of the inventory records, but most of the routine is used for the efficient use of the classification tracks in the area of track selection. It is not necessary for each group classification to be assigned a regular classification track, although in fact, most groups will have a regularly assigned classification track. Each car in a group will attempt to enter its regularly assigned track, if one was specified. If the yard has one hump with two hump leads running down it into the classification yard, and if the train is being humped in a two-hump-lead mode, and if a car must enter a classification track on the opposite side of the classification yard, the car is humped to the center cross-yard track, where it remains until it is rehumped. If the car's regularly assigned classification track or tracks are full, or if a regularly assigned track was not specified, the model attempts to select a swing track for the car. The selection of a swing track is based not only on the existing conditions in the classification yard, but also on future conditions that an actual yardmaster might anticipate, based upon the advanced consists that he has.

On the outbound side, a very important decision is made by the model concerning the cut-off time for an outbound train. This decision is based upon the schedule, upon yard conditions, upon the volume of traffic present for a given train, upon inbound connections, and upon the traffic available for humping in the receiving yard with cars that could be carried by the outbound train. When a train cut-off time is established, the model will decide which track or pair of tracks to use for the outbound train. In the case of a simulated yard with no departing yard, the outbound trains are made up on pulling leads. The selection of a pulling lead becomes very crutial, because the economy of such a yard requires that trains be made up simultaneously. Thus, the model selects the best pulling "route".

We have discussed the decision-making capability of the model, because in the past it has been somewhat supressed, largely because computing hardware was not of sufficient size to permit extensive decision-making logic. We have not discussed all of the decision-making capabilities in the model, but have mentioned some of the more important decisions made by the model. Naturally the decision-making capability reflects Penn Central operating policies, and is not absolute. It is up to an analyst preparing a yard model for a specific railroad to determine the policies and circumstances important to the efficient operation of a yard, and include appropriate decisions to fulfill these policies and satisfy these circumstances. Many computer simulations need not involve decision-making, but we believe that a Yard Model must make extensive use of decision-making logic to realistically and realiably describe a freight yard.

MANAGEMENT INFORMATION

Simulation of automatic classification yard operations using a digital computer have proved very beneficial for Penn Central in design of two automatic yards; one at Selkirk, N.Y., the other at Columbus, Ohio. Simulation enables designers to forsee operations and make best possible design.

A lengthy discussion of applications of a yard model is almost an insult to previously written work describing freight yard models. For review, a list of some possible applications follows: (1) Evaluate performance of a new yard design; (2) Determine the effect on traffic of new yard construction; (3) Determine the effect of a change in operating policies and resource assignments; (4) Evaluate freight schedules where effected by a freight yard, and test the effect of schedule and grouping changes; (5) Develop long-range freight yard plans based upon projected traffic levels; (6) Determine and evaluate sets of decision-making criteria to be employed in a supervisory control computer in an automated freight yard.

One of the first uses of the Penn Central model was to evaluate the performance of a new yard design. The model was used to simulate the yard with both existing traffic and with a proposed traffic change. Plans were made to perform a simulation of the proposed yard with a projected traffic level, and to simulate the yard while it was under construction and only partially operating.

Because of a variety of circumstances the major emphasis of application has been shifted to the simulation of existing facilities. Simple changes are being evaluated, and plans have been made to use the yard model to evaluate and improve the advertised schedules.

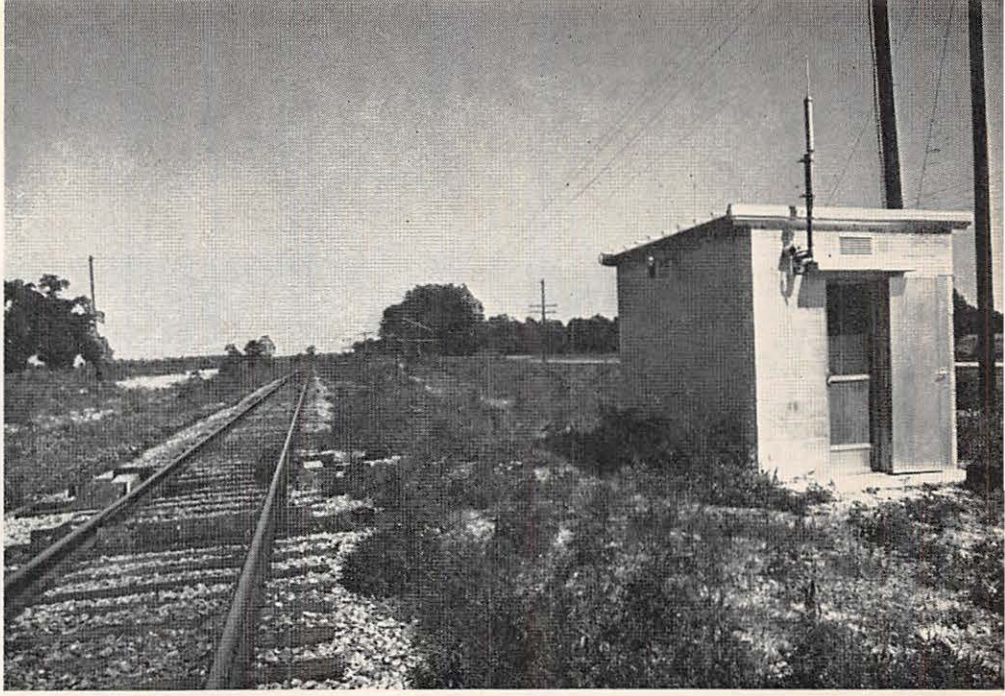
These applications have been of the obvious type, and have been all discussed in some detail by others. However, one application that hasn't been discussed too frequently involves using the model to determine and evaluate the rules for train processing that would be programmed into a process control computer in a largely automated freight yard.

While extensive gains in automation have been made in certain areas of manufacture, and while discussions involving automation of a railroad freight yard have been held, the railroad industry still has some work to be done to achieve a satisfactory operation. One reason is that a set of rules for efficient management of the facility is very difficult to develop. The Penn Central yard model has a set of rules for efficient management of the model yard. It follows that, since the model contains essentially the same elements that an actual freight yard contains, the set of rules is applicable to the management of an actual yard.

If such an application of the Yard Model is made, the rules should be adjusted and refined to reflect a specific yard with a specific type of traffic. As the yard or the traffic changes, the rules should be changed appropriately.

The model itself also indicates what information must be provided to a controlling computer (and, incidently, to a human manager) to efficiently manage the yard. If the cost of providing certain information is excessively high, a new set of rules can be developed which does not contain the costly information, and the new rules can be evaluated through the model.

SCL uses bin-loop tapes for hb dets



VHF RADIO STATION at each hotbox detector location "talks" to trains.

Seaboard Coast Line is using Ampex Corp., FB-500 bin-loop reproducers at 27 hotbox detector locations to provide recorded messages to passing train crews.

As the train passes a detector location, components of the system are automatically activated. Simultaneously, a counter begins counting the axles of the train; the infrared detection sensors search the train's axles and bearings for higher-than-normal temperatures; the bin-loop reproducer begins playing pre-recorded information which will aid in identifying the exact location of any overheated areas; and the computer-switcher receives information from the counter and sensors which enables it to retrieve the proper data from the reproducer which is transmitted by radio to the train crew.

The FB-500 is well suited for this application because its 14-channel capability makes it possible to record large amounts of verbal and numerical information. The information is later coded or decoded for identification purposes. Also, in bin-loop recording, no time is lost in rewinding the tape as with conventional reel-to-reel recorders.

SCL records the railroad name, city and state on one channel. The word "left" is recorded on another channel, and the word "right" on another. Numbers such as 000, 111, 222, etc., are recorded on the remaining channels.

When the computer-switcher receives a message from the counter and sensors, it programs the recorder to play back only the designated channels. Thus the computer might call for channels 1, 2, 7, 9, and 10 to be played. The message might read on channel 1 stating "first hot box"; "right" on channel 2; side on channel 1; and the remaining channel might identify the axle number such as 689.

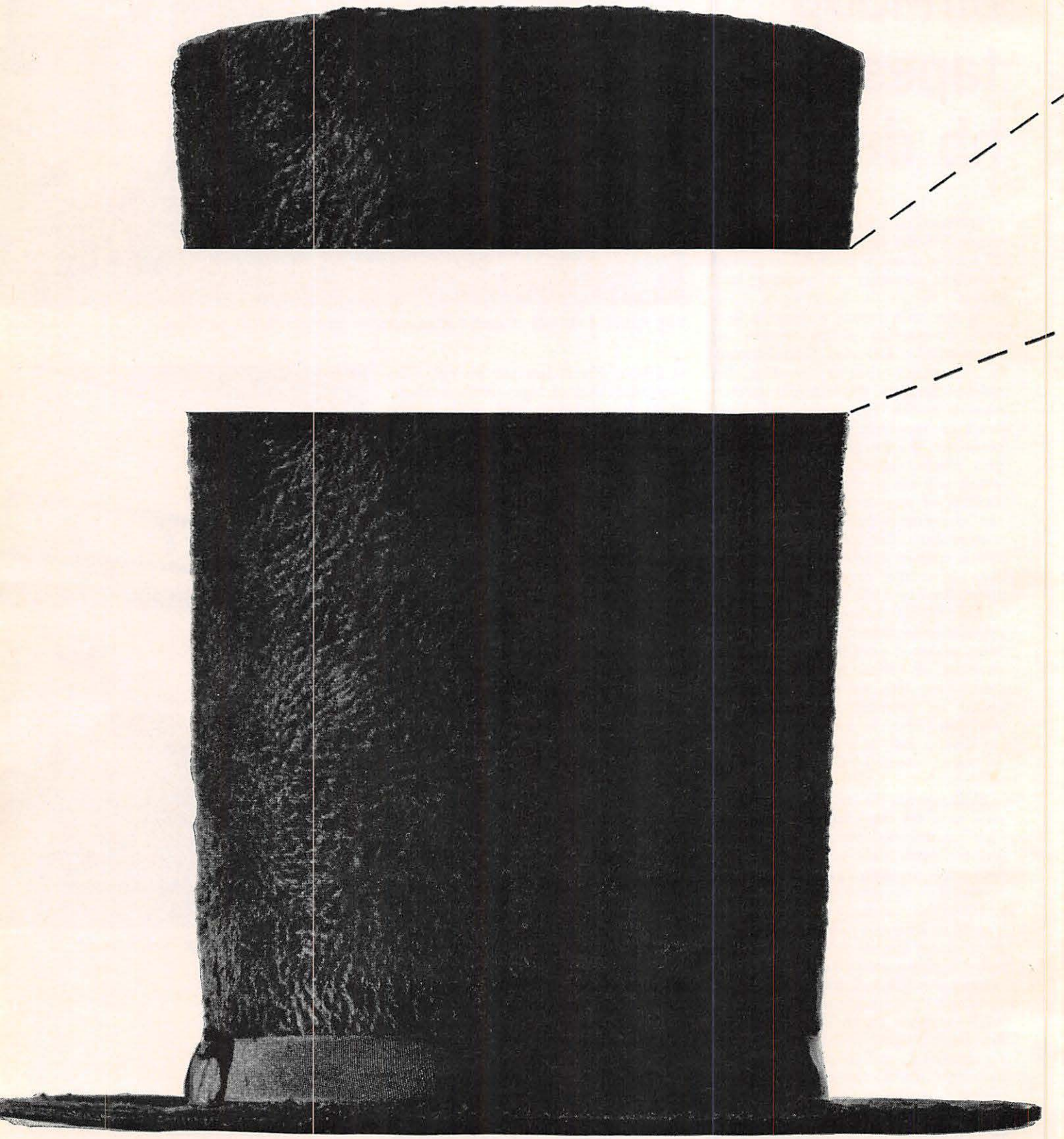
Another feature of the FB-500 used by SCL is that it uses up to 100 ft of one-inch wide magnetic tape for a long playing time. Tape lengths can be as short as 3 ft. The tape can run continuously in a loop at 1⅞ or 3¾ inches per second. The continous loop of tape needs no handling or rewinding and will operate for many thousands of passes without any appreciable reduction in performance. The tape loop is encased in a bin which protects the tape from adverse environmental conditions. The FB-500 operates reliably in temperatures ranging from 50 deg to 130 deg F.

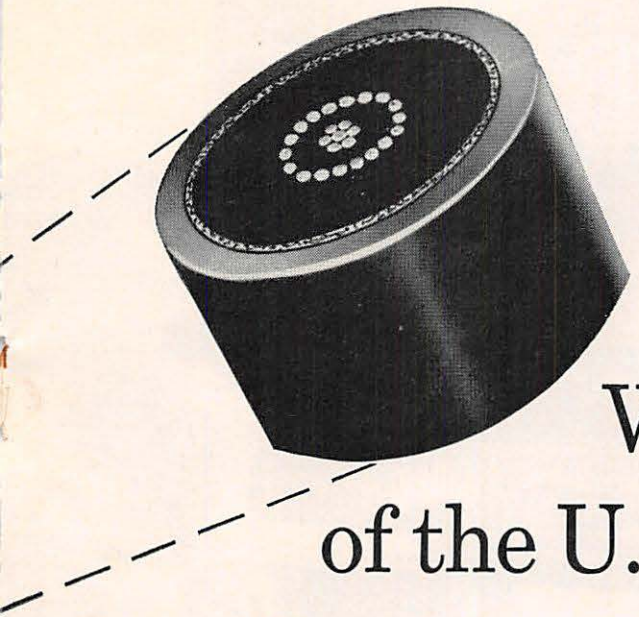
A reduction of flutter, permitting clearer, more reliable recorded information is made possible by a unique feedback mechanical servo. The servo corrects perturbations which are often caused as the tape is drawn from the bin storage area. Fast start, play and stop are possible without sacrificing gentleness of tape handling since there are now heavy reels of tape to bring into motion. The system is small, occupying only 19.25" of standard relay rack height.

As the train travels past the detection system at speeds up to 90 mph, the FB-500 plays only identification information such as "SCL" Railroad, Jacksonville, Florida." This message will be repeated until the train is past the detection system or until a malfunctioning hotbox has been detected. In such a case, the identification message will discontinue and the train crew will receive information locating the hotbox. If there is no trouble the train is told it has "No Hotbox" and the systems shut off automatically after the train has passed.

In an effort to insure complete safety of the train and its freight, a white and red light are placed at each detection location. The white light turns on if the system is operational. But enginemen must stop the train if a red light is on and cannot proceed until the hotbox has been examined.

BIN-LOOP REPRODUCER has "voices."





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DISPATCHER'S CONSOLE features telephone and radio communications plus

Chicago Transit Authority installs

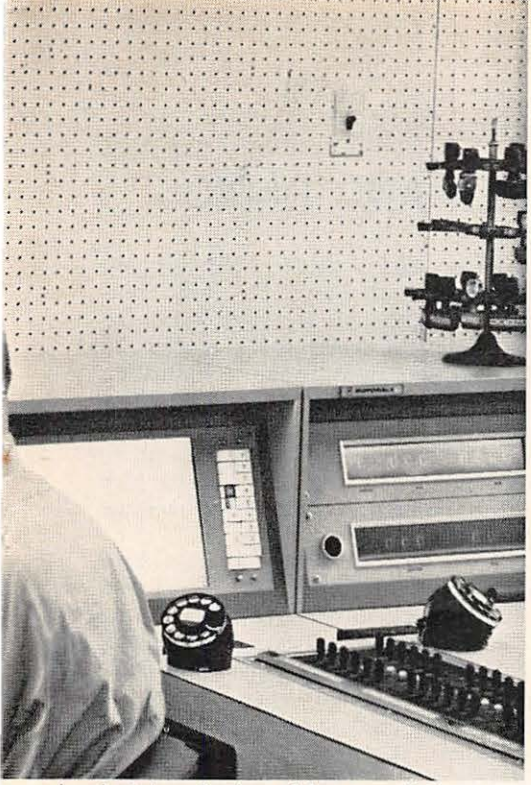
BUS OPERATOR has two-way communications with central dispatcher.

Automatic monitoring of bus operations is being employed by Chicago Transit Authority to improve its service to the public. Monitor-CTA combines the technologies of two-way radio, electronics and on-line, real-time computing to provide data for control of 500 buses.

"The primary purpose of this project is to furnish a constant flow of information to transit management so as to improve schedules and routes; to provide two-way digital and voice communication with buses, and to automatically monitor bus location and compares the operation with a prepared schedule within the Chicago metropolitan area.

"As a bonus, the system also features a safety emergency notification system. With this equipment, the driver can report accidents and robberies, and in special instances mechanical breakdowns," said Carlos C. Villarreal, administrator, Urban Mass Transportation Administration, at dedication ceremonies in Chicago on March 12. Monitor-CTA is a $2 million demonstration grant project. UMTA is providing $1,549,000 and CTA the balance of $451,000.

The demonstration grant project covers 500 of CTA's 3,300 buses, but the system could be expanded to include the entire fleet. Presently, the 500 buses comprise CTA's "owl service" fleet that



visual status display of bus monitoring.

MANAGEMENT INFORMATION

Chicago Transit Authority has installed an electronic control facility to improve operations of its 500-bus owl fleet running between midnight and 5 a.m. Known as Monitor-CTA, the facility consists of a computerized vehicle-location and identity system that will monitor bus schedules; a silent radio alarm system that will instantly transmit the location, bus and run numbers of an operator in need of help; and a two-way radio system that will provide communications between the bus operator and the dispatcher.

At various points along bus routes there are low-powered radio transmitters. Each is assigned an identification number, which is constantly being transmitted at sufficient power to reach a passing bus (within about 200 ft). The bus receives this radio signal and stores the identity number. Meanwhile at CTA's headquarters a computer interrogates a different bus every 83.33 milliseconds via a central radio transmitter. The individual bus receiving its specific interrogation code will respond via its radio with its identity (bus and run number) and location (number of the last wayside low-powered radio transmitter passed) and elapsed time since passing that transmitter. The computer checks the bus message against the schedule. If out of schedule, a message is printed out on the central dispatcher's CRT display unit.

bus-monitor system

operates between 12:00 midnight and 5:00 a.m.

The Monitor-CTA project, as the system is called, consists of a computerized vehicle location and identity system that will monitor bus schedules; a silent alarm radio system that will instantly transmit the location, bus and run numbers of an operator in need of help; and a two-way radio system that will provide full time communications between the bus operator and a central dispatcher.

Location is accomplished by placing small low-powered radio transmitters at various points along the bus routes. These transmitters, called "signpost" transmitters, are usually located at the intersections of routes and at fairly even intervals in order to provide an efficient and economic coverage. Each signpost is assigned an identification number which is converted into a 10-bit binary code and wired into the signpost's location information generator. The generator uses this code to form a message consisting of a series of digital pulses. The message, which is being repeated continuously, is then fed into the telemetry transmitters, converted from pulse to tone, and modulated onto a radio signal. Since the message length is very short, there is no great need for speed; therefore, very little bandwidth is necessary to transmit this message, eliminating the necessity of a voice grade channel. This allows the effective use of the "between channel" frequency space or a "splinter frequency". A frequency in the 150 MHz is used for the signpost.

On the bus is a location receiver which receives the signal from the signpost as it is passed. By keeping the power of the signpost very low, the range of the transmitter can be kept at a minimum near 200 ft insuring that the bus is at the signpost or near enough to assume that it is at the signpost. While the bus is in range of the signpost, it receives and demodulates the signal back to a "chain" of tone signal messages. These are reconverted into pulses and fed into an error detector. When the message is determined to be correct, it is placed into the location information register, erasing the previous signpost number, and stored until another signpost is passed and the cycle repeated.

In conjunction with this equipment is an elapsed time generator and counter. The generator, once started, puts out a pulse every 12 seconds and the counter counts the pulses and stores the count in a register. When the bus comes in range of a signpost, the count is reset to zero and the generator is stopped. This indicates, that if elapsed time count is zero, the bus is at the signpost whose number is stored in the location information register. Once the bus is out of signpost range, the generator is restarted and a count is begun. This indicates how long ago the bus was at a particular signpost allowing calculations to be made if a bus is not at a signpost when it is interrogated. In those cases where the location is desired, the elapsed time can be multiplied by the schedule speed and a distance from the stored signpost can be calculated.

The interrogation cycle is controlled by the GE/PAC 4020 digital computer at the Merchandise Mart. One by one, at 83.33 millisecond intervals, the computer outputs through the computer interface to the vehicle address generator, the coded bus identification numbers. The vehicle address generator converts the code to a series of pulses which are converted to tones by the telemetry transmitter which, in turn, are used to modulate the data transmitter. This is quite similar to the cycle described for the signpost. One base station radio transmitter is used to cover the entire metropolitan area.

Also similar to the location cycle is the data receiving process on the bus. All buses receive the data signal, demodulate it, convert it to tones, then to pulses, and check it for errors in the same manner as with the location signal. The identification number from the error detector is then fed into the vehicle address comparator. This com-

BUS MONITOR SYSTEM COMBINES COMPUTER AND RADIO

pares the number of the bus to be interrogated to the number (run number) which the bus operator has set into the equipment with the thumbwheel switches (in the CTA system a coded garage number is also prewired into the bus for further identification.) If the numbers do not compare, which is true in all but one case, nothing else occurs until the next data signal is received and the cycle is repeated. On the one bus where the numbers do compare, a data transmission is initiated.

In addition to the identification number, there is a system address code in each message. Once comparison is made, this number is decoded and used to control equipment on the bus. Presently it indicates a request for location data or voice communication; however, in the future with additional equipment it can request other data (passenger count, engine status, etc.) or control indications to the operator (time to leave terminal, ahead of schedule, etc.). The location information (last signpost number and elapsed time count) or the requested information is then coded into a series of pulses, processed and transmitted by the vehicle's data transmitter. As it is with all mobile radio transmitters, the range is less than that of a base station; therefore, to insure that the radio signals (both data and voice) are received from the vehicles, a number of stellite receivers are located throughout the city and connected to the control center.

Signals from the buses are received by one or more of these receivers and processed individually. Priority detection circuitry, which is monitoring the outputs of each error detector, then selects the first valid reply and sends the message to the computer interface, where it is read into the computer.

Because of the high data speed used for interorgation, approximately 2000 bits/sec as opposed to 200 bits/sec in the location process, a wide bandwidth is necessary; this requires the use of a voice grade channel. The only frequency space available for licensing by the CTA was in the UHF Band where a channel consists of two frequencies; one frequency is for base to mobile and the other is mobile to base. This feature allows that one bus be interrogated; and, before the reply is received at the control center, the interrogation signal for the next bus is sent. This allows for maximum interrogation speed and, therefore, the minimum system interrogation time.

Once the computer reads the reply from a bus, a schedule adherence check is made on that bus. First, a check is made to see if new information is available from the location information. If the signpost number is the same as last interrogation, then no new information can be ascertained because the bus has been checked by that point already. An exception to this is if the bus is still standing at the signpost; in this case further checking can be accomplished. Next, the schedule is checked to determine if the bus is due at the next signpost. If new location information is received, then the bus is compared against that point to determine schedule adherence. In all cases the deviation is then calculated and compared to the tolerance limits. These limits are set up to allow the bus operator a considerable leeway to contend with usual traffic and passenger delays, yet give the dispatcher sufficient warning of a possible major interruption of service. If the deviation is outside the allowable tolerances, a message is displayed at the dispatcher's console on a cathode ray tube (CRT) display and a permanent record made.

Simultaneous operations

As mentioned previously, each mode of operation is occurring at the same time as the others. Each time a bus passes a signpost, the location cycle takes place. The interrogation cycle is continuous; it locates each bus on the street one by one and when it finishes, begins again. Similarly, the interpretation cycle is processing the replies as they are received in a continuous chain.

Two-way voice communication exists between the dispatcher and each bus. If the dispatcher wishes to talk to a particular bus, he simply "dials" that bus with a push-button type telephone device on the console. The selective call generator codes the identification number he has requested and places the "call" message between the interrogation messages going to the data transmitter. These messages look exactly like the interrogation messages except for the system address code. The signal is received by all buses, decoded, and the desired bus selected. The equipment then causes an audible alarm to inform the operator the dispatcher wishes to speak to him. In a similar manner the dispatcher can call all the buses on a particular route, all the buses from a particular garage, or the entire fleet. If an operator wishes to speak to the dispatcher, he picks up his handset, depresses the "talk" button, and gives his message. When he completes the message, he releases the talk button and awaits confirmation from the dispatcher. When the operator initiates a call, the equipment automatically transmits his identification, eliminating the need for him to give this information and saving message time.

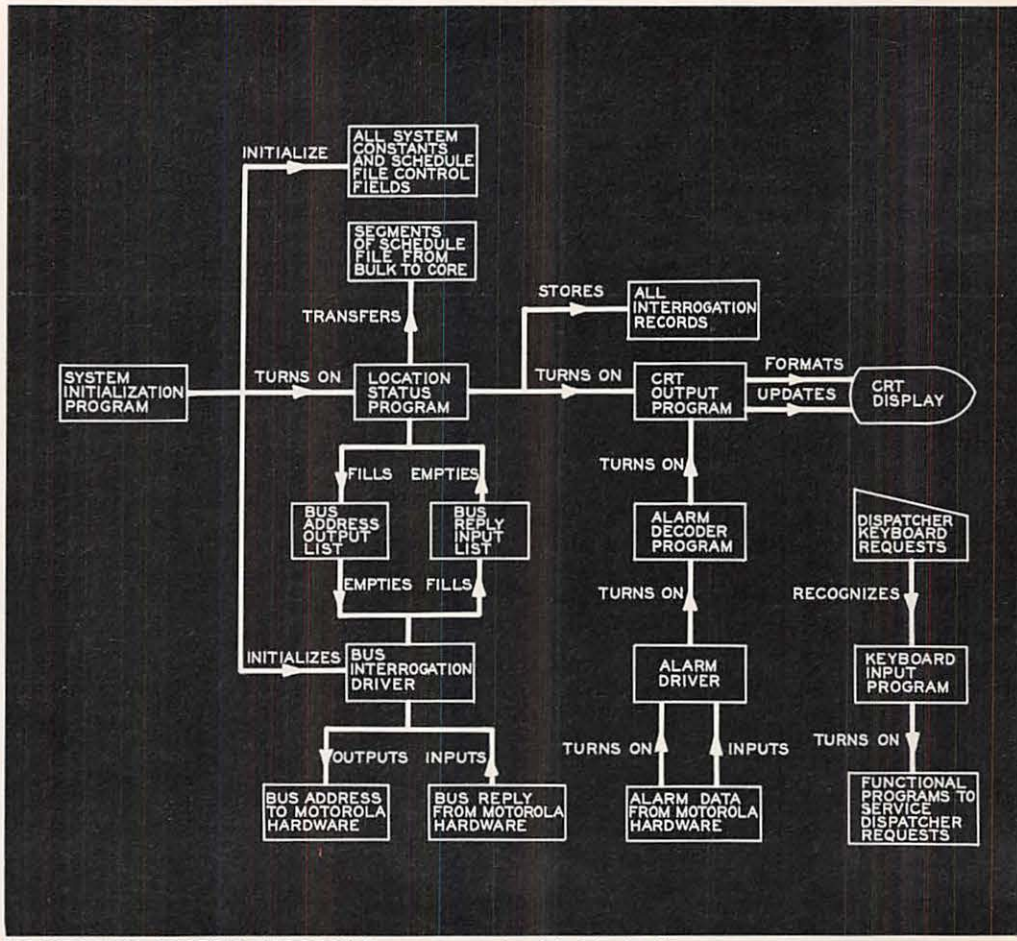
All voice communications are handled on a separate "voice" channel, and transmitted and received through the channel's own base station equipment. One transmitter covers the entire metropolitan area and three satellite receivers are used to pick up the signals from the buses. The signal from a bus is received at one or more satellites, demodulated, and sent over telephone lines to the control center. At the control center the signals from each satellite are fed into the voting equipment which selects the signal with the best quality for the dispatcher to hear. On the bus, however, there is only one set of radio equipment for both data and voice. The equipment is not only designed to operate on a two frequency channel but also on a number of channels. When the handset is removed from its holder, or cradle, the equipment switches from the data channel to the voice channel, and vice-versa when the handset is returned to the cradle. If an interrogation is attempted with a bus on voice, no reply will be made, but it is expected that voice messages will be short and, therefore, the bus will be "lost" for only one interrogation cycle if at all.

Another feature of the system is the emergency alarm. In the event of some emergency on the bus, such as a disturbance, sick or injured passenger, holdup or the like, the operator has a foot switch which turns on the alarm. When the switch is pushed, the equipment automatically switches to the voice channel and transmits, continuously for two minutes, the identification and the location of the bus. During this transmission there is no audible or visual indication of any equipment operation on the bus. After two minutes has elapsed, the equipment automatically returns to normal operation. The signal is received demodulated and brought to the control center, as with voice signals, but it is fed from the voting equipment into a telemetry receiver and then an error detector to select a valid reply. Next it moves into a data converter and the computer interface. The data converter

translates the information from binary to decimal, displays the results on the dispatcher's console, and sounds an alarm to alert the dispatcher. The computer interface generates an "interrupt", which orders the computer to act on the alarm message coming in. The computer reads the message, decodes the information, calculates the approximate distance from the signpost, checks if the bus is on schedule and makes necessary corrections, removes previous messages from the display screen, and displays the alarm message on the CRT. The speed of the computer allows all these steps to be accomplished in a few moments, allowing the message to be presented on the CRT at virtually the same instant the alarm is sounded. As an additional safety precaution, the equipment on the bus prevents the dispatcher from calling that bus and causing any indication that might endanger the operator or passengers.

Another aspect of the system is the storage and calculation capability of the computer. During a day's operation, many things occur to interrupt services; records are kept of major delays and the action taken to alleviate them. If a bus becomes disabled, a record is kept of disablements. The dispatcher will want to know if the operator of that bus is to be relieved, or he may wish to spread the headway on the street to cover for the missing run. Once the bus has reported its condition, it should be removed from the monitoring program until it is operational again. Spreading the interval and other service restoration techniques usually require adjustment of the schedule. The dispatcher must therefore be able to modify the schedule information in the computer. Once the bus is operable, the dispatcher will want to return the bus to the interrogation cycle, and to take the proper corrective action in returning the bus to schedule. These are just a few ideas for "between process" programs which are being contemplated. Because of the extremely high speed computer that is being supplied for this project, a General Electric GE/PAC 4020 with memory access of 1.6 microseconds, the calculations concerning schedule checking and monitoring should be accomplished in less than the 66-⅔ milliseconds between interrogations. With nothing else to do, the computer would spend the additional time waiting for the next reply. With the 4020 the "between process" time can be used to run auxiliary programs.

The computer in this project is a General Electric process automation computer, GE/PAC 4020, with a real-time multiprogramming operating system.

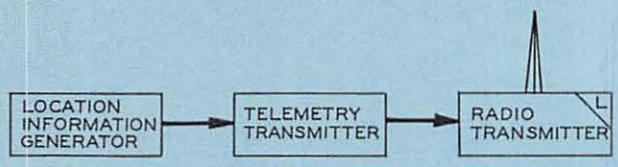


MONITORING SYSTEM PROGRAMS are shown in this block diagram.

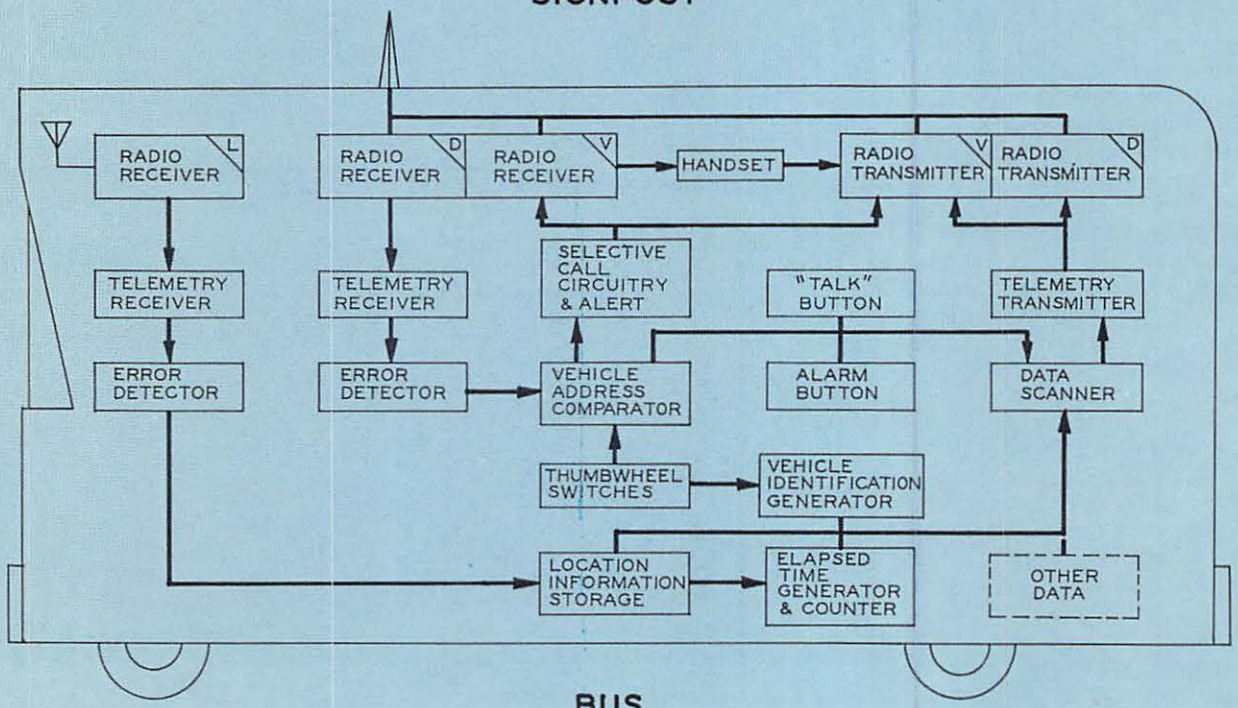
Peripheral devices for this system will be card reader, paper tape punch, paper tape reader, Model 35ASR Teletype, data link, 2 CRT displays controlled through a Datanet 760, magnetic disc memory, AU channel output, and digital input channels. The first five devices are for programmer communication with the computer. The card reader, operating at 100 cards per minute, is the primary program input device as well as for data input. The paper tape punch will be used by the compiler to record the machine language programs and as an auxiliary data output device. The paper tape reader is for loading the functional, machine language programs into the system, it could also be used for data input. The teletype will be used for programmer communication with the operating system for loading, debugging and manual control; it will also be used for some of the operating logging. The data link will be the major data input/output device; it will connect the 4020 with CTA's existing GE 415 business computer and high speed peripherals. Using this link, data from operations can be transferred to the 415, printed on a 1200 line per minute printer, and stored on magnetic tape. Also schedule data, which would take 35 minutes or more to read on the 4020, could be read in 3 minutes or less on the 415 using cards or magnetic tape, peripherals not present on the 4020.

The CRTs will be for display of off schedule information, alarm messages and dispatcher communication with the data system. Data requests by the dispatcher will be handled by a series of special functional programs turned on by the dispatcher from the display input keyboard. The dispatcher calls for the type of data he desires, the computer displays a questionaire to request information necessary to find the desired data, and then returns the data.

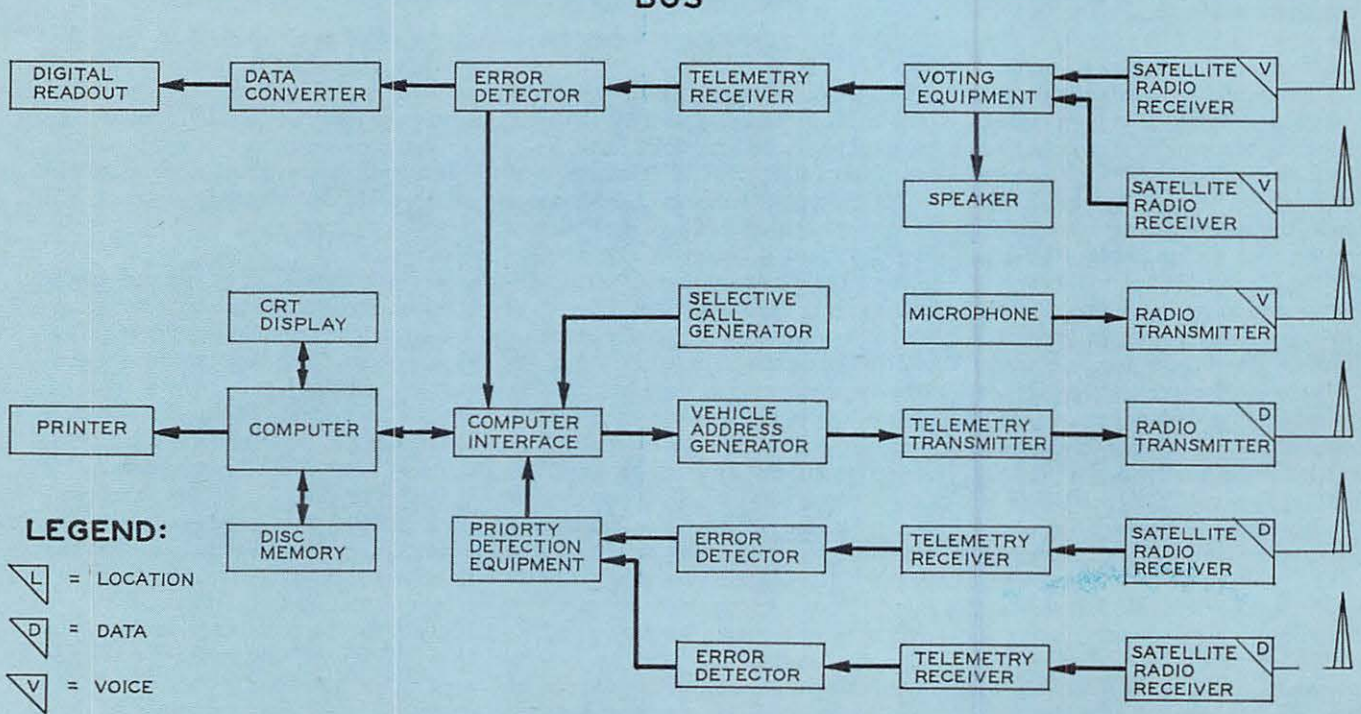
All interrogation messages are formed in the computer and output through the AU channel to a storage area in the interface in parallel (all bits at once) form. Each message is then sent in serial (bit by bit) form to the communication equipment for radio transmission. Reply messages are received through one of three digital input channels. They are stored in the



SIGNPOST



BUS



CONTROL CENTER

SMALL SPECIALIZED PROGRAMS ARE IN CONTROL

interface after they are decoded, and assumed to be present when the input command is executed. When the next message is decoded, it replaces the last message making the assumption that the last was already read. Alarm messages come to the computer on the other two digital input channels with one variation. When the message is received and is transferred to the interface, the computer senses the "changes of state" of the input lines. This generates an interrupt which starts the action necessary to interpret and display the alarm.

The actual schedule file is divided into five parts. The first part is the route words; seven words giving the system number, the early and late tolerances for that route, and the file linkage provides access to the runs, and to the trips. The second part is the running time table which contains the necessary timepoints and running times. Third is the run table. This contains the interrogation message in proper form, current operating status, and linkage to the running time table and the trip table. The trip table is next with chronological listings, one for each schedule direction of trip starting times. The table also includes, starting and ending points, linkage to the run table, the "running time update words" and linkage within the trip table. The running time update words are the changes to the running times made during the various trips. Each word in this last part of the file contains all the running time changes that a particular trip initiates.

Preliminary estimates have been made of each route file and a "map" of the complete schedule file devised. This map combines two or three routes, depending on the size, into blocks of 1000 words. As the monitor programs operate, a "block" is transferred from disc, or bulk memory, to core; the routes in that block are processed; and that block is returned to bulk and another transferred into core for processing.

In the programming of the system, the attitude was taken to have small, specialized programs in control. This approach would allow the best use of the operating system, permit the simplest program maintenance and debugging, and provide for the easiest program modification procedures. These monitor programs are: (1) LOCATION-STATUS, (2) BUS INTERROGATION, (3) CRT OUTPUT, (4) ALARM DETECTOR, AND (5) ALARM DECODER.

LOCATION-STATUS is the most important part of the monitoring system. To begin, it controls the transferring of route blocks in and out of core; this includes checking if the block has any runs to be processed or being processed. The program determines the run working a trip in progress or about to begin, forms the interrogation message and places the message in the address output list. Next it takes the response from the reply input list and determines schedule status. In all cases every response is stored on disc to provide data for project evaluation; but when an off schedule bus is discovered, the necessary information is placed in the CRT output list, and the CRT output program is turned on. Since the interrogations are conducted by route and direction, all schedule deviations will be similarly grouped on the CRT display.

PROPOSED COMPUTER PROGRAMS

Changing tolerances,

Stopping a bus from being interrogated,

Modifying schedule for one trip,

Obtaining data about leader or follower,

Adding a trip,

Changing a run number,

Requesting detail schedule,

Requesting relief information,

Finding location of a particular run,

Entering records of maintenance calls,

Changing running time,

Logging radio messages, and

Determining where a delayed bus should be.

The BUS INTERROGATION routine operates every 83.33 milliseconds. It reads the response from the last bus interrogated and places the result in the reply input list for location-status to process. Next it removes the message from the top of the address output list and presents it to the communication equipment. If the reply list were ever to be filed to capacity, the interrogation program would not address the next bus until room became available in the list; this is to prevent a response from being read and having no place to store it.

The CRT OUTPUT program takes the data from the CRT output list, the off schedule buses determined by location-status, forms the data into the proper format, and transmits the message to the display. By keeping track of what and how much is displayed, this program removes the data the dispatcher has acted upon and moves the list up so that the "oldest" data is on the top line. When the display is filled, this program signals location-status to stop processing replies until room becomes available on the display.

The ALARM DETECTOR is another very small program which senses an alarm message coming in, reads that message, stores the data in an assigned location and turns on the alarm decoder program.

The ALARM DECODER program determines the route the troubled run is on, and transfers that route block into core to determine direction and last known status of the run. A distance from the last signpost is calculated using an average operating speed, and the data is placed in an alarm output list. The CRT output program is turned on, takes the data from the list, and forms a flashing alarm message on the display screen. The data is also stored for a permanent record.

Besides the monitor programs which control the communication system, there is a series of programs controlled through the keyboard on the console. The keyboard input program recognizes a request from the dispatcher for particular data which is not usually displayed. The input program turns on the program that finds this data. The individual program displays a questionaire on part of the CRT asking for the route name and run number. The dispatcher types this in, the information is determined, and the proper display is made on the CRT.

Data Sheet

189

DATA MODEM CHARACTERISTICS

Manufacturer	North American Phillips	North American Philips
Model	DD2001 Data Modem	DD2002 Data Modem
Transmit and/or receive	Transmit & receive	Transmit & receive
Full and/or half duplex	Full duplex	Full duplex
Dial up or private line application	Private line	Private line
Turn around time (HDX)	Not applicable	Not applicable
Automatic answer capability	No	No
Type modulation	AM vestigial sideband	AM vestigial sideband
Operating frequencies	700-2600 Hz at 3600 bits/sec	600-3100 Hz at 4800 bits/sec
Clock, internal or external	Internal	Internal
Loop back testing feature	No	No
Error rate	1×10^{-5}	1×10^{-5}
Error detection and/or correction	No	No
EIA RS-232-B interface	Yes	Yes
Bit or character rate	600, 1200, 2400, 3600 bits/sec	3600 or 4800 bits/sec
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	600	600
Impedance to data equipment, ohms	Demod. 600; Mod. 5,000	Demod. 600; Mod. 5,000
Voltages to and from data equipment	RS-232-B	RS-232-B
Frequency stability	—	—
Level stability	—	—
Output levels to line, dbm	−20 to +3	−20 to +3
Input levels from line, dbm	−35 to +5	−35 to +5
Line requirement, frequency response	±2 db 700-2600 Hz at 3600 bits/sec	±2 db 600-3100 Hz at 4800 bits/sec
Line requirements, envelope delay	±0.2 ms 700-2600 Hz at 3600 bits/sec	±0.1 ms 600-3100 Hz at 4800 bits/sec
Line requirements, impedance, ohms	600	600
Line requirements, signal to steady noise	22 db for 3600 bits/sec	24 db for 4800 bits/sec
Line requirements, signal to impulse noise	—	—
Method of operation	4 wire	4 wire
Temperature and humidity limits	Zero to 50 deg C Zero to 95%	Zero to 50 deg C Zero to 95%
Power requirements	117 or 220 volts AC	117 or 220 volts AC
Dimensions and weight	15.75" x 16" x 22.5"	15.75" x 16" x 22.5"
Digital or analog	Digital	Digital

Note: Information was prepared by L. J. Ritter, Manager of Communications Plans and Operations, Penn Central. Reprinted by permission of John McNabb, Engineer, Communication & Signal Section, AAR.

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- average repair time: 8 minutes
- priced $75 to $100 lower than competitive models

WABCO 3R/3V/3D
- 3R—locomotives, cabooses and base stations
- 3V—vehicle trunk mount
- 3D—vehicle dash mount
- smallest 35 watt radio on the market
- plug-in modules
- transmitter and receiver interchangeable with all WABCO models
- low standby drain
- accessories for any system
- proven reliability and performance in railroad market for 1½ years
- quiet line (tone squelch)

WABCO

An American-Standard Company

Circle 11 on reader service card

RAILWAY SYSTEM CONTROLS

News Briefs

C&S spending rises in '69 over '68

According to the Economics and Finance Department AAR, class I railroads in the United States spent $65,352,000 for communication and signal material in 1969 compared to $64,263,000 in 1968.

Vapor reorganizes transportation sales

Vapor Corp.'s transporation systems division is divided into three market groups: railroad, mass transportation and industrial. **James A. Machesney** appointed market manager-mass transportation and **A. M. Jarzombek** appointed market manager-railroad.

Intermodal works with IC on terminal control

A new subsidiary, Terminal Control Systems, Inc. of Intermodal Transportation Systems, Inc. has obtained an order from the Illinois Central for the installation of a terminal control system at its Intermodal Exchange in Chicago. The new control system, especially adapted for piggyback and container terminal control, will use automatic car identification. The new control systems are particularly applicable to piggyback trailer container type of equipment because of their great mobility and will, according to Palmer Bayer, Intermodal president, "enable railroads and other transportation companies to improve their yard and terminal operations through the control of the movement of equipment."

Intermodal's subsidiary, Terminal Systems, Inc., is directed by **William J. Radcliffe**, vice president and general manager, and will work very closely with Computer Identics Corp. in developing and marketing the piggyback terminal control systems.

NYCTA to have ATC on 240 transit cars

New York City Transit Authority's 240 new 75-ft cars, now on order, will be equipped with automatic train control including cab signals with over-speed control, automatic speed regulation and program station stopping. The equipment is to be supplied by General Railway Signal Co. by a contract amounting to over $1 million from Westinghouse Electric Corp.

The automatic train control system will provide for monitoring of train speeds and maintain them within ± 2 mph of the speed command which is transmitted via track circuits through the rails. Cab signals will display the commands to the motorman.

Included in the contract will be equipment to provide automatic and programmed station stopping. To provide for this, receiving equipment on each train will respond to wayside equipment in advance of each station which will cause the train to decelerate in a proper manner to bring it to a correct stopping point at the station.

Panduit appoints sales rep for southwest

Panduit Corp., has appointed Ransom Sales Co., Inc., sales representatives for its full line of wiring components and accessories in Arkansas, Louisiana and Mississippi. Ransom sales is at P.O. Box 9269, Little Rock, Ark. 72209. **David L. Ransom** is president and **Joe A. Rolf**, field sales engineer.

AAR opposes proposal of FCC to raise fees

When the Federal Communications Commission recently announced plans to raise an additional $20 million by an increase in filing and grant fees, it was deluged with protests, including one from the AAR. The railroads objected to the proposed $19 fee for initial issuance and renewal of safety and special radio services permits. Increased cost to AAR would be about $28,000 annually. The work in renewing licenses is "closely comparable to that required for the issuance of duplicate licenses," AAR said. Cost of a duplicate license is only $6, which AAR suggested should be the fee imposed for renewal of any license.

Telpak rates are now competitive, says AT&T

American Telephone & Telegraph Co.'s bulk communications tariff, known as Telpak, is competitive with private microwave systems, reported a company spokesman at a recent FCC hearing. Of five railroad account managers for AT&T, four maintain that their customers would not go to privately-owned facilities under the present Telpak rates, said Charles H. Miller, AT&T long lines department general marketing manager.

He did say that one of his account managers reported that one customer had a large underground conduit system and would utilize this plant and replace some of his Telpak services. It was estimated that 164,000 telephone and 120,000 teletypewriter channel miles would shift from Telpak to railroad-owned facilities.

Label deadline set for Jan. 1, 1971

All equipment in interchange service on the railroads must be equipped with automatic car identification labels by Jan. 1, 1971. "As no further extension of the effective date will be granted, it is imperative that the application of labels be expedited during the remaining period of favorable weather to the conclusion of this important program." So stated an announcement by W. H. Chidley, executive vice-chairman, mechanical division, AAR, extending the deadline from June 1, 1970.

Estimates are that railroads have spent about $17 million labeling cars, locomotives, trailers, containers and work equipment. A sampling of opinion at the recent Data Systems Division forum in Denver indicated that the January 1, 1971 deadline will be met. "There is too much at stake not to meet it," was a typical comment. Reports from several railroads having test installations of ACI indicated an overall accuracy of 95% or greater. Missouri Pacific is currently conducting a fourth round of ACI tests at its Dupo, Ill. yard. The yard is bracketed by five scanners with Teletype output into the yard office. A test sample of 2,055 cars indicates 82.14% of the cars passing the scanners have valid labels, and correct output data has been obtained on 96.8% of those labels.

Estimates are that 75-80% of the car fleet is now equipped with ACI labels. Some railroads are close to completion. However, there was concern shown at the DSD meeting about the accuracy of label application. Indications are that about 3% of the labels are incorrectly applied. Misreading has been caused by labels placed too low on flat cars or on curved sides of tank or covered hopper cars. Revised instructions now provide for placing of ACI labels "entirely between 6 ft. 0 in. and 9 ft

6 in. above top of rail, whenever possible."

To make it easier to label trailers and TOFC/COFC flat cars, DSD's Ad Hoc committee on ACI has recommended that TOFC equipment codes 2 and 3 be placed in the piggyback formatted option, along with containers. Present requirements are that there must be a 6 ft horizontal spacing between labels on trailers and the car carrying the trailers. The basic ACI system, with the 6 ft label spacing, can read trailers on flat cars. However, with the recommended change, the basic ACI system would only read labels on cars.

Reasons for the change, says the Ad Hoc committee report, are to eliminate labeling restrictions on trailers and flats (no 6 ft horizontal separation between labels required). It has been noted that prescribed labeling areas often fall directly in the path of piggyback crane arms, resulting in serious label damage.

Also, container labels have always been in the formatted option. A survey of railroads indicated that where trailer data is required, container data would be required and vice-versa. Also, some containers are moved as trailers with the bogies. If this recommendation is accepted by the DSD and Mechanical division general committees, it should speed up labeling of trailers and containers. Also it will allow the placement of labels in a more readable location on low-level flat cars.

FCC oks unlimited Telpak sharing

By a 4 to 1 vote, FCC commissioners ordered telephone and telegraph companies to "file revised tariffs that will extend the benefits of the Telpak shared rates to all private line customers, without regard to their lines of business." This, say users and Bell System spokesmen, probably means the end of Telpak in its present form. New tariff filings are expected about August 15.

According to *Telecommunications Reports,* an AT&T spokesman said that "Careful study of the Commission's order, which has not yet been released, will be necessary before we can say what the effect of the decision might be on the future of telpak service.

"Our main concern from the start, of course, has been the adverse impact that unlimited sharing of this service would have on the rates to present telpak users."

In clearly seeking some alternative to telpak, the FCC order last week stated that "AT&T should remove the discrimination we have found herein to afflict Telpak sharing by appropriate tariff revisions which will extend the rate benefit to be derived from sharing to the other private line users.

"It is particularly important that the revised practices be designed so as to maximize the opportunity for each user of private line services to have equal access with all other users to the private line rate benefit inherent in Telpak sharing. In this connection, it would appear that appropriate measures must be taken to prevent a 'customer' under the Telpak rate to treat his sharers of that rate in a discriminatory fashion."

Rejecting a staff "arbitrage" suggestion in the hearings. the Commission pointed to the "potential for discrimination in a practice that would require each private line customer to go to some middleman to form or join a group in order to obtain the benefits of the Telpak rate," and said "we do not view this alternative as the ideal or perfect method by which to remove the present discrimination."

In reaching for a solution, the Commission continued with the observation that "we would much prefer to see all customers treated as one overall group of sharers in the use of the carrier's total facilities and all entitled to equal access to the same interexchange channel rates by applying directly to the carrier rather than to an intermediary."

But, it declared, "all of these objections to unlimited sharing already exist with respect to those favored users who are now permitted to group together to obtain the Telpak rates. Therefore, the adoption of unlimited sharing would put users not now permitted to share the Telpak rates on an equal footing with those who can now share under the present limited sharing practices and would thereby eliminate the discrimination in the Telpak sharing practices that are in issue herein.

"Moreover, such adoption would give users now discriminated against alternatives and options which they do not now have in their quest for equality of rate treatment for like services. It is particularly for these reasons that we view the alternative of unlimited sharing as the best of the alternatives discussed herein."

The FCC noted that "it is AT&T's position that the effect of any prescription by us of unlimited sharing would be the eventual demise of Telpak rates because of the effect upon the telpak cost/price relationship.

"Counsel for AT&T claimed at oral argument that if a private line customer could make arrangements with another private line customer to share a percentage of the Telpak C or D rate in obtaining his private line circuits, this would increase the number of interexchange channels utilized under a given telpak base capacity without any increase in charges therefor, with a consequent increase in costs to the carriers of providing IX channels under Telpak rates without any compensating increase in revenues; would not be a productive business for the telephone companies; and would not provide any competitive advantage over private microwave."

In a discussion of the private microwave statistics provided by AT&T as part of the hearing record, the Commission said that assuming the figures do show that extensive sharing of private microwave is going on by those also eligible to share Telpak, "an examination of the evidence does not indicate that such microwave sharing growth has been affected by the original Telpak sharing offer or would be currently affected by the elimination of Telpak sharing. This, in fact, intimates that those presently utilizing the majority of private microwave are doing so for reasons with which AT&T cannot compete. . . .

"At the present time, there are three main groups sharing private microwave—namely, power, petroleum, and railroad companies. The dominant factors in the record concerning rights-of-way and the existence of communication uses peculiar to these groups are their ownership of these industries."

A review of the evidence in the case about those groups, it stated, "leads to the following conclusions: (a) railroads and utilities both have rights-of-way making private microwave more economical to them than to groups not having rights-of-way; (b) the need for reliability, flexibility of service, and control requires, in many instances, that these groups use private systems; (c) Some portion of the communications requirements of these industries is satisfied on the basis of cost alone; and (d) at least one group of users (the smaller railroads) probably does not have private microwave as an alternative."

The FCC concluded on this score that, "on the basis of the evidence that we have analyzed, it has not been shown that shared private microwave has been an attractive alternative for certain groups; i.e., the airlines, truckers, and motor bus carriers, and that, at best, it possibly has been attractive for other groups, such as the railroads, power, and petroleum industries because of their particular communications needs and their ownership of rights-of-way."

(Please turn to page 42)

Product News

Data set can operate up to 1800 bits/sec (101)

A new data set capable of providing "voice band", full duplex transmission of data at speeds up to 1800 bits per second between customer-owned business machines and data processing equipment is fully compatible with the WE "202C" and meets EIA standard RS-232B interface between business machine and data set. The L2202C data set, with a built-in six-button key telephone auxiliary set, provides for alternate voice and data communication between telephone stations (1) in the exchange and toll switched voice message (DDD) network and (2) in private lines or leased lines. Data communication between customer-owned business machines and computing or data processing terminals is made possible through interface connections with an appropriate data set on the telephone line at each end of the circuit.

Options available with the L2202C data set include the provision for: answering and disconnect or call origination in either the manual or the automatic mode. The data sets are packaged in an attractive two-tone gray, high-impact plastic cabinet designed for desktop operation. *Lynch Communication Systems.*

Digital instruments in new catalogue (102)

An instrumentation products catalog (Bulletin 368B) features a new line of digital instruments. Model 2700 digital system is offered with four DC voltage ranges capable of precise measurement from .0001 to 999.9 volts. Plug-in modules for this instrument are available for DC current and resistance measurement. Four and five digit electronic counters provide accuracy within ±0.01% ±1 digit and can measure average frequencies (up to 20 MHz), time interval, period and frequency ratio and can totalize pulses over a selected period.

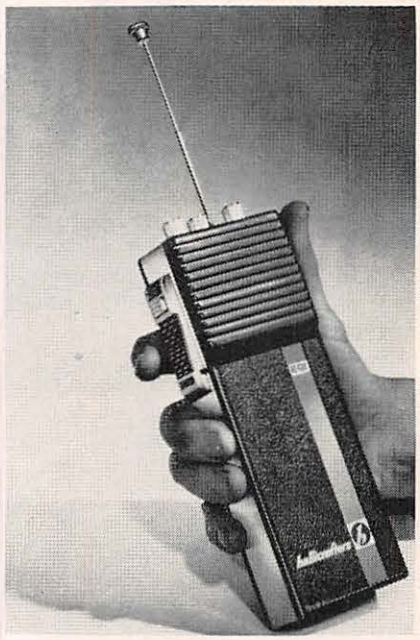
A new completely portable RLC bridge measures resistance, inductance, capacitance and "Q." A versatile line of miniature strip chart recorders for measuring AC and DC quantities plus temperature are also included. A complete line of secondary standards including instruments for measurement of power and milliohms round out the listing. *Simpson Electric Co.*

Portable unit checks insulated joints (103)

Model 1501A portable insulated joint checker is designed to check the integrity of insulated rail joints, insulated gauge plates, insulated switch rods and other rail devices where accurate insulation resistance measurement is difficult to obtain. A self contained transmitter/receiver combination transmits a calibrated 50 KHz signal into the insulation, and internal circuitry translates the AC impedance encountered into a reading on the unit meter.

The device is battery powered by 8 "D" cell batteries contained in cabinet.

Specifications include: Input voltage: 12 volts DC nominal (10.5 to 14.0 volts DC); Sensitivity: 0.5 to 150 ohms; Ring-by: less than 10 ft; Battery consumption: approximately 50 ma. Selector switch offers battery check point, 0–15.0 ohm scale, 0–150.0 ohm scale and calibrate position. The 1501A is housed in a rugged weather-proof box, 9" x 6" x 8". Weight is approximately 7 lb (with batteries). It is compatible with DC, AC and audio overlay track circuits (does not require shunting the track). *Harmon Electronics Inc.*



Portable radios have 4-watt power (104)

A solid-state, 4-watt, personal/portable FM 2-way radio, the model series HC-400 for the 450-512 MHz frequency range, is available in three longlife battery powered versions, field adjustable continuous tone squelch option and numerous accessory and power combinations.

The model series HC-400 consists of three rugged FM 2-way radio versions. All require a 12.0 volts nominal power supply. All are battery operated.

HC-400, the basic unit, measures only (HWD) 7.5" x 2.78" x 1.3". It is available with one or two channels and with noise squelch. It weighs but 28 oz. with its compact Nicad batteries. The batteries provide the unit with a 5-5-90% duty cycle (5% transmit, 5% receive, 90% standby) on a minimum of 8 hr per charge.

A second version, an expanded service unit, is identical to the basic unit with the exception that it is designed for use with a heavy-duty Nicad battery and it has a 1.5" depth. The battery provides a 5-5-90 duty cycle on a minimum of 16 hours performance per change. On a 10-10-80 duty cycle battery life is a minimum of 8 hr per charge. Its total dimensions are 7.5" x 2.78" x 1.5". It weighs 35 oz. with battery and is available with up to 2 channels and/or continuous tone squelch.

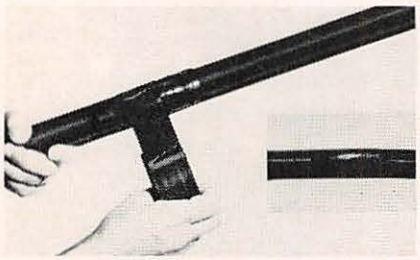
The third version is the deluxe

channel, 4-watt, 5-5-90 duty cycle unit, measuring 7.5" x 2.78" x 1.7", weighing only 39 oz. This unit can be equipped with any standard EIA continuous tone squelch frequency. A unique feature of the HC-400 series is the ability to field adjust to any of six tone frequencies within one basic tone module.

Each of the compact, hand-held transceivers is constructed with a 6¼" whip antenna, telescoping internally. Hi-Gain and insulated spring types of antennas are available as options. Controls adjacent to the antenna port on the top of each transceiver model include: Power on/off, volume, squelch, and accessory jacks for lapel microphone, earpiece speaker and multi-channel select switch. A low profile, push-to-talk transmit switch on the side of the unit provides for rapid thumb actuation for voice communications and tone disable.

The vibration and shock specifications of the new Hallicrafters units exceed those specified by EIA. Temperature rating is-22 deg to 140 deg F.

Each of the small, lightweight transceivers in the HC-400 series are constructed with rugged aluminum frames and high impact plastic covers. The handsome case is finished in durable dark grey accented with a silver trim and knurled aluminum control knobs. *The Hallicrafters Co.*



Pressure-sensitive tape seals and shrinks (105)

Heat-shrink, self-sealing tape offers a new concept for weather sealing and insulating mechanical or electrical connections. This laminated tape has a pressure-sensitive contact adhesive to hold it in place prior to heating. When heat is applied, the outer surface (a thermally stabilized, irradiated, modified polyolefin) shrinks longitudinally causing moltent sealant on the inner wall to flow within the wrappings and fuse to the taped surface. Any heating device capable of delivering 275 deg F can be used, although hot air sources (such as electric guns) are to be preferred over open flame propane or butane torches.

When properly shrunk, the tape provides a flame-resistant, self-extinguishing, moisture-proof shield. The material itself is non-hygroscopic and resists fungus and weathering. With a dielectric strength of over 450 volts per mil this 0.020" thick tape can be used as an insulating material over 9,000 volts DC.

A standard roll contains 54 ft and is available in three widths (¾", 1 ½" and 3"). *American Pamcor Inc.*

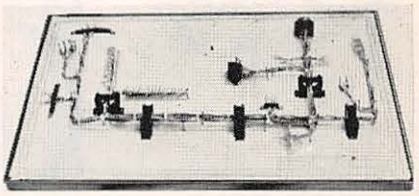
Data sets operate up to 230 kbits/sec (106)

Data sets of digital communications up to 230 kilobits per second are described in Bulletin ECD-11A. The publication contains information on mounting facilities, modes of operation of the systems' baseband data sets, repeaters and carrier modems. *General Electric Communication Products Department.*

New track circuits use audio frequency (107)

A completely new vital transistorized Audio Frequency Overlay (AFO II) line of track circuit equipment features low or high power transmitter selection for maximum application flexibility. (Operates over a range of battery voltages from 8.8 to 16.2 volts DC). Extended range for both low and high power transmitter to increase the variety of possible applications; and a new plug-in package for easy maintenance.

Components are mounted on plug-in printed circuit boards contained in a new Unimodule package. The units are plug-in or wall mounted. The Unimodule is 7¼" wide x 5½" high x 11" long. Width and height dimensions are the same as the PN-250 relay. Built-in surge protection is provided to eliminate the need for separately packaged equipment. Vital circuits are designed to avoid unsafe failure modes. Twelve frequencies are provided to minimize the effects of possible harmonic interference. Carrier modulation is available to further minimize possible noise interference, for those applications requiring this feature. *Signal & Communications Division, WABCO.*



Wiring speeded by jig board system (108)

A new Pan-Board wiring harness jig board system is a proven concept for faster wiring harness assembly, and offers the advantage of re-use of the board and accessories instead of requiring extensive storage space. The new jig board comes in a standard 2-ft by 3-ft size. Larger harnesses are fabricated by joining two or more boards side-by-side or end-to-end, by means of a special lip incorportaed into the Pan-Board design.

The jig board consists of layers of stainless steel screen separated by layers of honeycomb material. In use, an engineering drawing or blueprint of the harness to be built is taped on the board, and various wire holding accessories are attached to the board according to the layout. Using the accessories to define the wiring path, wires are installed in the normal manner.

The available accessories include a unique and versatile "snap-in, snap-out" elastic retainer which automatically forms round bundles as the wires are inserted. Uniform, tight harnesses are thus insured when cable ties are installed. Other accessories include the fanning strip assembly to isolate conductors at the proper place; straight and bent harness pins to define the wiring paths and hold down the harness; and coated harness springs to secure wire ends.

One of the main advantages of the Pan-Board system is the fact that it is immediately reuseable by simply removing the accessories and the drawing, and laying a new drawing on the board. This eliminates the need for extensive storage space to keep harness boards, and a large number of duplicate accessories. Only the drawing has to be stored for each type of harness. *Panduit Corp.*

Ansonia RR SC 108 Signal and Control Cable

. . . uniquely conceived, designed and manufactured to provide these advantages over other types of insulation and jacketing:

- Low density high molecular weight polyethylene
- Lighter weight . . . smaller diameter
- Greater dielectric strength . . . for years longer
- Greater electrical stability
- Greater moisture resistance

. . . plus these and other options:

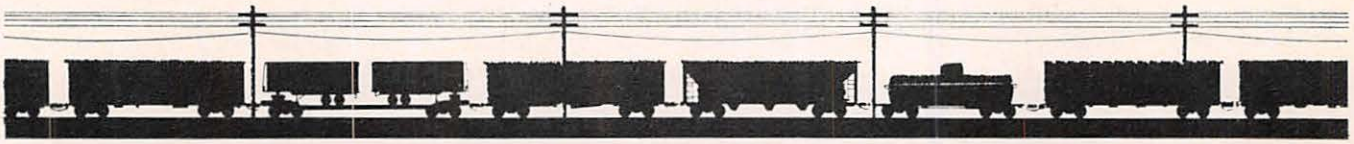
- 1 to 37 conductors . . . AWG 14 to 4/0
- Solid or stranded conductors
- Same gage or composite construction
- Unshielded or shielded . . . longitudinal or helical . . . copper or aluminum
- Shielded individual conductors . . . braided or metallic coated film

And finally the specifications for RR SC 108 assure you utmost reliability . . . finest materials . . . strict quality control checks at every stage of manufacture . . . all at lower cost.

Want more evidence? Ask our agent in your area or write for information.

Ansonia

The Ansonia Wire & Cable Co
Ashton, Rhode Island 02864
Telephone 401-724-6400



Ansonia Agents Servicing The Transit Industry

▪ National Accessories Company, Inc.
346 Suburban Station Building
1617 John F. Kennedy Boulevard
Philadelphia, Pennsylvania 19103
215-563-2603

▪ Clawson Railway Supply
9322 Manchester Road
St. Louis, Missouri 63119
314-961-5533

▪ Fitzhugh Railway Equipment Corp.
2500 West Broad Street
Broad Street Station
Richmond, Virginia 23220
703-358-7184

▪ Howe-Stephens Company
1826 Industrial Way
Redwood City, California 94063
415-366-9591

▪ Mikan-Hagerth Corporation
100 Church Street
New York, New York 10007
212-233-2286

▪ Modern Industries, Inc.
100 Outer Loop
P.O. Box 14287
Louisville, Kentucky 40214
502-361-1113

▪ Edward Moriarity
7 Deerfield Lane
Huntington Station
Long Island, New York 11746
516-271-1252

▪ B.W. Parsons Company
818 Pioneer Boulevard
St. Paul, Minnesota 55101
612-227-6511

▪ Western-Cullen Division
Federal Sign & Signal Corp.
2700 W. 36th Place
Chicago, Illinois 60632
312-254-9600

Ansonia
The Ansonia Wire & Cable Co
Ashton, Rhode Island 02864
Telephone 401-724-6400

Circle 12 on reader service card

Letters

Our new look!

Chicago, Ill.

To the Editor:

I'm seldom moved to write a letter of admiration for a magazine redesign—but I feel I have to in response to your latest offering. What a splendid, giant step forward.

John Mitros
Manager Public Relations
Illinois Central

Chicago, Ill.

To the Editor:

Our most enthusiastic congratulations to you and to the other members of the Simmons-Boardman organization who contributed to the bright, new colorful look of rsc for the '70's.

W. A. Costello
Advertising Manager
WESTERN-CULLEN DIVISION
Federal Sign and Signal Corp.

San Francisco, Calif.

To the Editor:

Congratulations! And thank you for a very excellent article. Your new cover is very attractive and eye-catching (I sincerely mean that even though I may be a little prejudice). I have received many other complimentary remarks.

R. L. Petersen
Director, Management Services Dept.
Western Pacific

Pittsburgh, Pa.

To the Editor:

RS&C for January looks fine. The other things I note is the somewhat new format in some of the articles and I think the entire book looks a lot better than it did before. My congratulations to you and keep up the good work.

John W. Hansen, Manager
Marketing Communications
Signal & Communications Division
Westinghouse Air Brake Co.

Atlanta, Ga.

To the Publisher:

I have just received the January issue of *Railway Signaling and Communications.* I want to congratulate you on the new format.

There appears to be changes other than just the front cover; and though I have not yet had an opportunity to read everything in the magazine that I wish to, I find that it is much easier to glance through and pick up the highlights than it has been in the past.

My congratulations to you, Mr. McKnight, and The Kerite Company for the change in image. It may be that this, among other steps being taken, will help in improving our image within the railroad industry, and we thank you for your help.

Thanks again for another "helping hand" to all of us signal and communications folks.

John T. Mattison
Assistant to Vice-President
Signal & Electrical Department
Southern Railway System

Richmond, Va.

To the Editor:

When I picked up the January issue of the magazine I thought to myself, who else is coming out with a trade magazine. The change in format is so startling it looked like an entirely different publication. After looking through this issue and reading the content, I would like to add my few words of congratulations to those I know you have already received on the improvement. Keep up the good work.

W. E. Prince, Jr.
Engineer Signals & Communications
Richmond, Fredericksburg & Potomac

Atlanta, Ga.

To the Editor:

I have read with much interest your April issue (Volume 1, #1) of *Railway System Controls.*

As I have mentioned to you in a previous letter, it is very encouraging to see the changes you have made in this Magazine. I am particularly gratified to see the educational value of the material you are publishing, and with your continued efforts along these lines, this publication will be an even more useful tool to the Signal and Communications People in the Railroad industry.

I was particularly interested in your April 1970 issue; namely, "Track Circuit Shunting Tested on Electrified Suburban Line" appearing on page 18; "How Tests are Conducted to Find Wheel-to-Rail Resistance" appearing on page 26; and "Oscillation of Wheel Effects Track Shunting" appearing on Page 30. It would be appreciated if I could have 100 copies.

Keep up the good work. I will look forward to seeing more of the same in future publications.

John T. Mattison
Assistant to Vice President
Signal & Electrical Department
Southern Railway System

People

AAR, ENGINEERING DIV.: Elsworth L. Abbott appointed secretary succeeding **E. G. Gehrke,** retired. Abbott, former assistant to executive manager, American Railway Engineering Association, appointed administrative secretary, AREA.

BROTHERHOOD OF RAILROAD SIGNALMEN: R. T. Bates, vice president, appointed secretary-treasurer succeeding **P. T. Drummond,** retired. **J. T. Bass** succeeds Bates as vice president. Both will be headquartered in Chicago.

BURLINGTON NORTHERN: W. R. Bjorklund, former NP director, industrial engineering, appointed director, operations administrations at St. Paul. **L. C. Bolger,** former GN director information services, appointed director information services at St. Paul. **A. L. Essman,** former chief signal engineer CB&Q, appointed director signal engineering at St. Paul. **C. Hungerford Jr.,** former CB&Q director industrial engineering, appointed director industrial engineering at St. Paul. **T. W. Wigton,** former CB&Q general superintendent communications, appointed director of communications, system, at St. Paul **R. Lehrke,** former GN signal engineer, planning, appointed regional signal engineer at Minneapolis. **D. C. Hill,** supt. coms. NP, appointed asst. director coms., St. Paul.

CHESAPEAKE & OHIO/BALTIMORE & OHIO: J. D. Nethken, Jr. appointed signal inspector, Pittsburgh, Pa. **R. P. Chandler** appointed signal application engineer, Huntington, West Va. **D. M. Kress** appointed signal draftsman, Huntington, West Va. **G. Workman** appointed manager transportation computer operations. **W. M. Hart, Jr.** appointed manager CLIC. **J. D. Maxey, Jr.** appointed assistant director-data control.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY: Joseph C. Kelly, treasurer-controller, appointed acting general manager, succeeding **Leo J. Cusick,** resigned.

NORFOLK & WESTERN: John A. Sattler, assistant to regional engineer of signals and communications, appointed assistant regional engineer of signals and communications at Cleveland, Ohio, succeeding **Herbert L. Hinton,** retired. **Clarence N. Russell,** supervisor of signals and communications appointed assistant to regional engineer of signals and communications at Cleveland, Ohio.

PENN CENTRAL TRANSPORTATION CO.: G. W. Steis appointed assistant industrial engineer at Pittsburgh, Pa.

RICHMOND, FREDERICKSBURG & POTOMAC: John H. Dobbins, signal draftsman, appointed assistant supervisor signals. **Andrew H. Lamothe, Jr.,** assistant communications inspector, appointed communications inspector.

SACRAMENTO NORTHERN and Tidewater Southern: **Bruce L. McNeill,** engineer signals and communications, Western Pacific, appointed to same position for these roads, with headquarters at Sacramento, Calif.

ST. LOUIS-SAN FRANCISCO: Jack S. Downs, superintendent signals, appointed general superintendent communications and signals succeeding **Oscar H. Summers** appointed assistant chief mechanical officer. **G. F. Groff,** communications and signals supervisor appointed superintendent signals.

SOUTHERN: Johnnie F. Norris, supervisor communications, appointed general supervisor communications, Salisbury, N.C. **James T. Stucker,** signal and electrical supervisor, Alexandria, Va., transferred in the same position to Somerset, Ky. **Gordon F. Woods,** assistant signal and electrical supervisor, Chattanooga, Tenn., appointed signal and electrical training coordinator, Atlanta, Ga. **Meek M. Winkle,** general foreman communications, appointed supervisor communications, Knoxville, Tenn. **J. C. Duncan,** general foreman communications, appointed supervisor communications, Greenville, S.C. **Richard F. Stepp,** assistant supervisor communications, Columbia, S.C., appointed supervisor communications, Sheffield, Ala. **Billy Charles Edwards,** signal maintainer, appointed signal and electrical construction supervisor, Birmingham, Ala. **Clifford P. Beach, Jr.,** assistant supervisor communications, Princeton, Ind., appointed electronics specialist, Brosnan Yard, Macon, Ga. **Harold V. Duncan,** foreman communications, Greenville, S.C., appointed assistant supervisor communications, Columbia, S.C. **Arthur C. Eiland, Jr.,** telephone maintainer, appointed assistant supervisor communications, Princeton, Ind. **C. Hoye Welch, Jr.,** assistant supervisor communications, Chattanooga, transferred in the same capacity to Birmingham, Ala. **Joseph L. Walton III,** telephone maintainer, appointed assistant supervisor communications, deButts yard, Chattanooga, Tenn.

Suppliers

ANSONIA WIRE & CABLE CO.: **Neal C. White** appointed director of marketing.

McGRAW EDISON CO.: Kenneth S. Young, former signal supervisor Canadian Pacific, appointed manager of sales and production, Primary Battery Division, McGraw Edison of Canada Limited, with headquarters at Scarborough, Ont. **Joseph E. Drennon,** assistant to vice-president and division manager for Primary Battery Division, Thomas A. Edison Industries, Bloomfield, N.J., has retired.

Donald C. Hill
Burlington Northern

Roger Lehrke
Burlington Northern

T. Wayne Wigton
Burlington Northern

Jack S. Downs
St. Louis-San Francisco

Neal C. White
Ansonia Wire & Cable

Kenneth S. Young
McGraw Edison, Can.

Robert A. Lockwood
Servo Corp. America

W. E. Trantham, Jr.
Sylvania Electric

Glenn J. Cullom
S&C Div. Wabco

W. R. Fisher
S&C Div. Wabco

KERITE CO.: Allen Hubbard III, former sales manager of the wire products division of Lewis Engineering Co., appointed marketing manager with headquarters in Seymour, Conn.

LYNCH COMMUNICATION SYSTEMS: William J. McLain appointed communications engineer, major accounts. with headquarters in Chicago.

RAILWAY SYSTEMS DESIGN, INC.: Charles M. Hursh, former system application engineer, Marquardt Industrial Products Co., appointed chief engineer. Gene K. Adams, former sales manager, Chicago division, MIPCO, appointed project engineer. Richard E. Risely, development engineer, MIPCO, appointed electronics engineer.

STREETER AMET: John A. Herb appointed sales engineer, Minneapolis.

SERVO CORP. OF AMERICA: Robert A. Lockwood, director of industrial marketing, elected vice president for national marketing.

SYLVANIA ELECTRIC PRODUCTS INC.: W. Earl Trantham, Jr., former vice president and director of advanced programs, Canoga Electronics, appointed manager of transportation control systems, succeeding John W. Barriger, appointed manager of transportation market development.

SIGNAL & COMMUNICATIONS DIVISION, WABCO: Glenn J. Cullum appointed sales representative, St. Paul, Minn. E. R. Callender appointed manager of research and development. E. O. Garrett appointed manager engineering services. L. K. Hedding appointed assistant to the manager engineering special projects. The eastern rapid transit regional office in New York and the central regional office in Pittsburgh, join the Atlanta regional office as field sales offices for the eastern regional office in Philadelphia. Sales personnel located in New York, Pittsburgh and Atlanta will report to W. R. Fisher, the manager, eastern region.

Allen Hubbard, III
Kerite Company

William J. McLain
Lynch Comm.

Obituary

A. L. STEVENSON, vice-president engineering and test, Harmon Electronics, Inc., died recently.

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NEWS BRIEFS

(Continued from page 35)

In dealing with private microwave as a competitive alternative basis for Telpak sharing, the FCC concluded that "we do not believe that the probability argument advanced by AT&T is a valid yardstick by which to gauge the threat of competition; rather, the carrier must have some persuasive and tangible evidence that there will be a shift to the alternative service unless the discrimination is maintained."

As to the argument of present Telpak sharers that the public interest is served by their lower communications costs, passed along to the public in their role as regulated carriers or utilities, the FCC said it "must conclude that there has been no showing made that the public interest is served any more by those now entitled to share Telpak than it would be if non-sharers were accorded the same opportunity . . .

"Any public interest that may have been served by virtue of the Telpak sharing provisions has been because sharers have been able to reduce their communications costs—surely, non-sharers could make this argument if given the same opportunity to reduce their communications costs. Accordingly, we cannot equate the public interest argument advanced by the sharers with their private business interests . . . Moreover, for the purposes of this proceeding, we cannot see the relevance, insofar as the public interest is concerned, of whether the economic benefits are directly or indirectly passed on to the public."

Ultimately, the Commission stated that "We see no reason for assuming any greater public interest in the Telpak sharing practices than in the former limitations imposed on sharing of private microwave."

Further, it declared, "the fact that the present eligible sharers may experience increased communications costs or that such increases may have a disruptive effect on their business without shared Telpak cannot be controlling herein because present sharers appear to have had the benefit of an unlawful discrimination in the past by virtue of shared Telpak."

FCC consolidates three rates cases

Federal Communications Commission has reconsolidated the Telpak/private line and program service rate cases. FCC said it was consolidating the cases "because all of the services involved in these two dockets are subclassifications within the family of private line services governed by AT&T's private line tariff No. 260. We believe there will be questions of fact and law common to all of the services that can better be handled in a consolidated proceeding. Moreover, many of the parties in each of these two proceedings are also parties in the other. Consolidation will be a convenience to such parties."

According to *Telecommunications Reports*, the FCC said it sees no need to amend the hearing order to include a specific reference to Telpak, "since it is clearly encompassed within the ordinary private line services which were named in the ordering clause." It further disagreed with the proposal that Telpak rates be considered in a separate proceeding.

"Since the Telpak rates are an integral part of the rate structure within the private line services, we do not believe that we can properly determine the appropriate rate level or rate structure for Telpak in isolation from or without regard to the relationship of the Telpak rates to the non-Telpak rates for like services," FCC said.

BART control testing advancing rapidly

BART's computer controls are well along as far as program debugging is concerned. Testing of electrification and train control equipment in place got under way last month. Southern Alameda yard is complete. Philco-Ford is installing yard train controls. Work is about 50% complete at Richmond and Concord yards. The last contract for electrification has been let.

Long Island to spend $420,000 for radio

Long Island has placed a $420,000 order with Radio Corp. of America for a two-way radio communicatons system covering the road's police, supervisory and maintenance vehicles, offices and stations.

The two-way network will make use of mobile radios for vehicles, pocket-sized portables for individual use, and radio base station equipment at major control points and railroad block stations. The system's 43 transmitters will be able to reach key railroad people on the highway or wherever they carry portable radios or "pocket pagers," with emergency messages. Operation will be on frequencies in the 160-mHz band.

The RCA base station equipment also will be used to communicate directly with train radios, and during emergencies LI officials in the line's Jamaica headquarters will be able to speak directly to passengers over public address systems in the cars. Mobile radios for automobiles and trucks will be RCA's Super-Fleetone 500, an all-transistorized type that are capable of transmitting and receiving on four channels.

UP to replace radios on rolling stock

Union Pacific will install RCA Series 700 four-frequency mobile radio units as replacements for older equipment on locomotives and other rolling stock, as well as in motor vehicles. The series 700 are all solid-state design which eliminates tubes, mechanical current switching and separate power supplies. For train use, radios will be installed with a special mounting which UP will supply.

GT completes radio network in Michigan

Grand Trunk Western put the finishing touches on one phase of a train-radio communication network with the installation of a 150 ft radio tower next to a new transportation and communications building at its Battle Creek yard. Last of a series of nine major towers spread over a three-state area, the structure will boost communication signals over the section of GT mainline between Lansing, Mich. and South Bend, Ind. Towers at these locations and at Detroit, Chicago, Port Huron, Durand, Pontiac and Valparaiso make up the network.

The system will be used for two-way communication between yards, stations, dispatchers and trains. Portable radios mounted in GT cabooses will allow trainmen to send and receive information.

ICS announces new FCC license course

International Correspondence Schools has a new FCC Commercial Radiotelephone License Course. Students can enroll either in one or more divisions of the course, or in the whole course.

Division 1 is relatively short and covers preparation for the Third Class Radiotelephone License, with or without Broadcast Endorsement, (FCC Elements 1, 2, and 9). An optional section of division 1 includes preparation for the Radio Amateur Novice License.

Division 2 covers FCC Element 3,

or preparation for the FCC Second Class Radiotelephone License exam.

Division 3 covers preparation for the FCC First-Class Radiotelephone License (Element 4). A separate text also covers study for the Radar endorsement. The course is covered by the ICS double warranty.

All three Divisions include self-check review exams which permit the student or trainee to test his own knowledge with FCC-style questions; answers are provided separately as a guide to technical or specialized areas which require further review.

WABCO appoints field service rep for ACI

Mosler Safe Co.'s installation and field service organization has been named field service representative for ACI equipment manufactured by the Signal & Communications Division, WABCO. Mosler has 850 electronic and electro-mechanical technicians located at 91 service centers. More than 50 automatic car identification scanner systems have been purchased by American railroads from WABCO's S&C division.

DOT awards contract for LIM-TACV

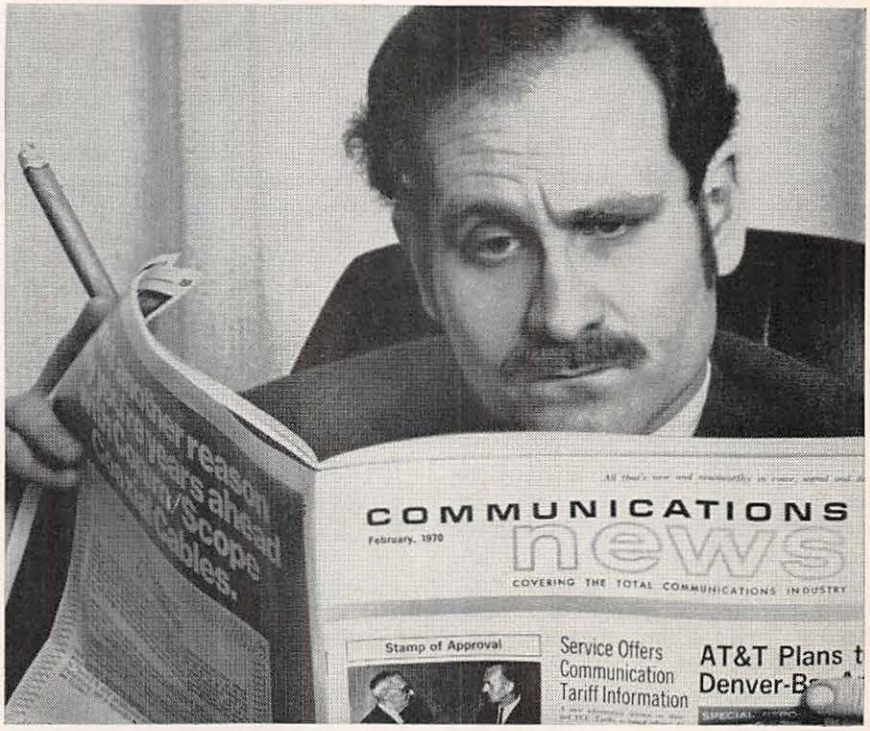
Secretary of Transportation John A. Volpe said that AiResearch Corporation of Torrence, Calif. has won the contract to design a high-powered linear induction motor for a 300 mph tracked air cushion vehicle.

AiResearch's contract will total about $770,000 for the design of a second generation, 8,000 hp electric motor to propel a tracked air cushion research vehicle currently being designed by Grumman Aerospace Corp.

AiResearch has already constructed and is testing a 2,500 hp LIM at its plant and will ship the test vehicle to the Federal Railroad Administration's newly acquired test facility at Pueblo, Colo. in early 1971. This vehicle rides conventional rails with steel wheels and is capable of speeds up to 250 mph.

The Grumman TACRV, which will be propelled by the AiResearch LIM, rides on thin cushions of air on a fixed guideway shaped like a "U". Centered in the guideway is a vertical aluminum reaction rail which interacts magnetically with the electric motor on board the vehicle to pull it down the guideway. The AiReserch design employs commercial-type, 60 Hz power picked up from the wayside which is conditioned to variable-frequency, variable-voltage up to 173 Hz required by the LIM.

If you want a tube distributor who knows your business, give it to him.



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Quality. Your RCA Industrial Distributor stocks the finest line of tubes for aviation, rail, mobile and fixed station communications. In power tubes, for example, brand preference studies conducted by leading electronic publications have listed RCA as the first choice of professional designers year after year!

Inventory. The widest. Transmitting tubes, receiving tubes, rectifiers, cathode-ray tubes, light-sensitive tubes, vidicons. Think of his establishment as your tube warehouse. For all practical purposes, that's what it is!

Need more reasons? Call your local RCA Industrial Tube Distributor. For starters, ask him for the new 1970 Guide to RCA Industrial Tube Products, or write: RCA Electronic Components, Commercial Engineering, Dept. 164G, Harrison, N. J. 07029.

RCA

Books

Tube/transistor guide aids substitution

This guide lists 99% of the tubes and transistors ever needed to be replaced. Moreover, only readily-available and comparably-priced substitutes are listed. This new volume contains 8 sections—four devoted to tubes and four to transistors. Section 1 provides a cross-reference of popular American receiving tubes, listing substitutes which have similar or superior characteristics and which require no mechanical changes or circuit modifications. In each case the best substitute is listed separately from others that can be used. Again, the most appropriate substitute is identified. American substitutes for popular foreign types are presented in Section 3, while Section 4 includes base diagrams keyed to the tube listings in each section.

The transistor portion begins with Section 5, which contains a complete listing of popular American types and the most readily-available, popularly-priced substitutes. Section 6 lists American substitutes for the most often encountered foreign transistors. Section 7 is a listing of general-purpose replacements for popular original equipment types. Here are substitutions chosen from the general "all-purpose" types offered by leading manufacturers. For the purpose of lead identification, Section 8 includes base diagrams which are keyed to the original type listings.

1970 Popular Tube/Transistor Substitution Guide. TAB Books, Blue Ridge Summit, Pa., 1970, Price: $4.95 leatherette bound; $2.95 paper.

Computer fundamentals is introductory text

"Fundamentals of Digital Computers" is an introductory text to the general field of electronic computing. It begins with a discussion of various types of computer applications, surveys the history and evolution of computers, and then covers the fundamental facts about computers and their operation. Detailed is the functional organization of a computer system, individual components of system data preparation, storage devices, input and output peripheral devices, conversion units and the central processor.

An explanation of how problems are solved with a computer is presented along with a discussion of three of the most popular programming languages—FORTRAN, (the most nearly universal programming language); COBOL (programming language most suited for business application); and BASIC (a popular time-sharing language).

A glossary, a bibliography and three appendices are included. Appendix A lists the companies that manufacture computers; Appendix B contains a list of computer science periodicals that may be of interest to the reader; and Appendix C identifies several of the professional computer science organizations.

Fundamentals of Digital Computers by Donald D. Spencer, president, Abacus Computer Corp., Howard W. Sams & Co., Inc., Indianapolis, Ind., 1969, 304 pages, 5.5" x 8.5". Price: $6.95.

MIS handbook is a guide for management

Developed by engineers at Philips data systems division, this comprehensive guide to management information systems can serve as a planning and operating tool for any firm planning computer-based MI systems.

The handbook consists of six sections. Subtitled ARDI, an acronym derived from the pivotal activities in the methods advocated—Analysis—Requirements Determination—Design and Development—Implementation—the handbook expresses the thought process that occurs, not only in these four main activities, but at a very detailed level throughout a project.

Balancing the systems engineering aspects of a project, the authors also discuss management's relation to the organization and guidance of an integrated effort. Stressing the importance of management, from an initial decision, through implementation and evaluation, the volume provides ample evidence of the balance needed between any company's strategic goals and its managerial and operational control requirements.

I Introduction—concept of an organization, purpose of ARDI, scope of ARDI, ARDI approach to the systems effort, subdivision and updating, and terminology. II Project management—organization of the systems effort, project planning and control, costs and benefits of an information system, project documentation and change control. III System analysis and design—define the problem, analyze present system, identify system requirements and constraints, design new system, divide system into subsystems, review system specifications and prepare master plan. IV System development—develop subsystem, specify program requirements, specify procedure and forms requirements, preparation for conversion, develop programs, develop procedures and forms, prepare system description, test subsystem, and complete user documentation. V System implementation and evaluation—conduct training program, install equipment, prepare operating schedules, convert programs and files, begin new operations, and evaluate information system. VI Techniques and standards—Management techniques, documentation, data gathering, design and development, control techniques and programming.

Management Information Systems Handbook by W. Hartman, H. Matthes, A. Proeme, McGraw-Hill Book Co., New York, N.Y. 1969, Price: $29.50.

Circuit design book covers semiconductors

This book is about semiconductor circuit design and analysis. Written with the needs of technicians and engineers in mind, the author begins with a look at semiconductors—diodes, transistors, FETs, MOSFETs, thyristors, SCRs, triacs, diacs, etc.—how they are constructed and how they work. Chapter 3 provides an in-depth analysis of amplifier circuit design, with guidelines for analyzing AC circuit characteristics. Pulse and switching circuits are discussed in Chapter 4, along with an array of useful multivibrator data.

Chapter 5 contains a detailed discussion of computer logic using digital ICs, with many circuit examples and a discussion of basic AND-OR/-NAND-NOR functions. A similar treatment is given to operational amplifiers. Following a discussion of what opamps are and how they work, the author describes several currently-available opamps and the uses for which they are designed. Chapter 7 explains the use of modern math for analyzing circuit operation.

Solid-State Circuit Design & Operation, by Stanton R. Prentiss, TAB Books, Blue Ridge Summit, Pa., 1970, 288 pages, Price: $9.95.

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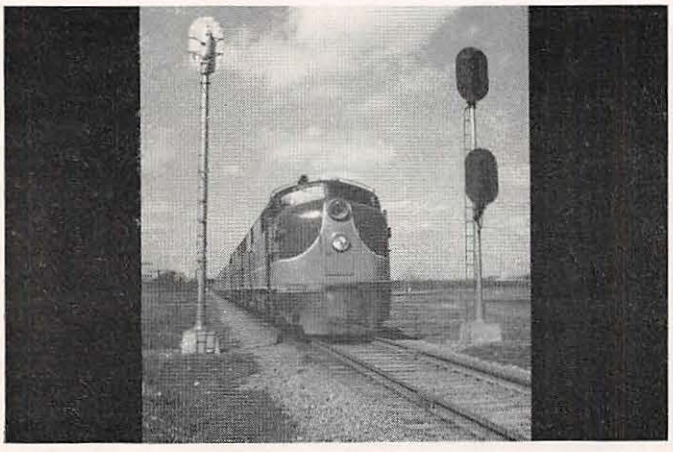

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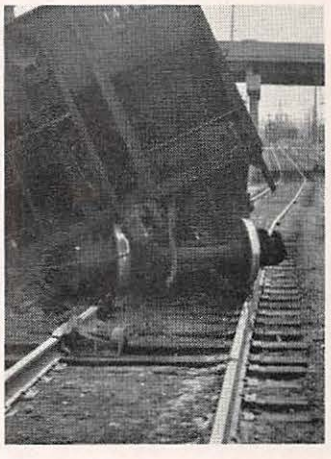

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Editor's Corner

Planning involves details as well as vision

Almost every major railroad in the U.S. and Canada is involved in management information and control systems. Competitive necessity, survival and the large size of the enterprise—particularly after mergers—require the total systems approach. Also, it is becoming apparent to some observers that only by the cybernetic approach with its attendant tremendous computer power or capability can these larger railway systems be operated efficiently.

Although most papers presented at the Third International Symposium on Railway Cybernetics dealt with specific cybernetic applications, all implied or stated the importance of or relation to management involvement. Also receiving considerable attention at the Tokyo meeting, were papers dealing with planning and implementation of total systems for management information and control.

INSIGNIFICANT MAY BECOME VITAL

The systems approach to planning, say those involved, not only is concerned with the total subject—often called the grand design—but must be concerned with a myriad of details. Also, one must consider all phenomena or elements of the area under consideration that may ultimately be of concern regardless of their present apparent insignificance.

For example, present railway concern over high voltage direct current transmission is with interference to signal and communications circuits. One such HVDC line is about to go into operation between the Bonneville Power dams on the Columbia river in Oregon and the city of Los Angeles, Calif. But a longer range consideration is warranted because of such factors as economy of bulk power transmission and air pollution controls. It might well be economically and politically feasible for electric utilities to construct mine-mouth power plants away from urban areas. One large generating station could probably produce as much power as several generating stations in urban areas. Smoke control devices installed at these mine-mouth plants would probably not have to be as expensive as the units installed in urban areas, simply because they could be less effective due to their remoteness from population and industrial centers. Also, it might be feasible to generate direct current (eliminating one AC-DC conversion station) for bulk transmission via HVDC lines. Experts estimate that an HVDC transmission line over 500 miles long costs about 20% less to construct than a comparable high voltage AC line. Thus for the longer range, HVDC may prove a formidable competitor to railway coal hauling traffic for power generation.

This is but one example of the types of problems facing planners. New technologies often foster ramifications and results unforseen in original plans. Thus it is essential to continually review and update plans in light of changing conditions and the passage of time. No plan is ever really completed—it is superseded by another picking up where the first one left off. Once a system has been installed or become operational according to a plan creating the system, new plans must be formulated to take care of future operations including any changes that may be necessary to make the system effective.

As for planning, Chicago architect and planner Daniel Burnham had these comments: *"Make no little plans. They have no magic to stir men's blood and probably themselves will not be realized. Make big plans; aim high in hope and work, remembering that a noble, logical diagram once recorded will never die but long after we are gone will be a living thing, asserting itself with growing intensity."*

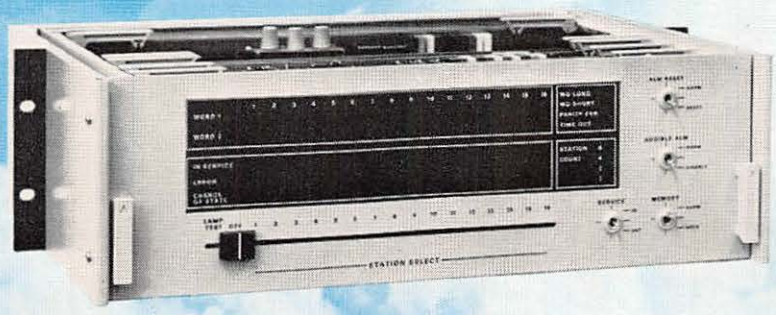
PLANNING AIDS OUR WORK, TOO

Just about one year ago, we made preliminary plans for our new look and our new name—RAILWAY SYSTEM CONTROLS. After six months of the new look and three months of the new name, I can report modest success. Comments have been most favorable about our new venture (see page 39). But we are not content to stand still. Planning is now underway for next year's issues.

Special thanks go to our understanding and cooperative publisher Robert Lewis. The new look—front covers and article layouts and complete visual redesign are the work of our talented art director Maurice Mates, who is commended for his fine work.

Also, grateful acknowledgement is extended to the following companies' public relations and management services departments for the outstanding color photographs used on our front covers: January-Western Pacific; February-Canadian National; March-General Electric; April-Illinois Central; May-Westinghouse Electric; June and July-Santa Fe.

Monitor an entire microwave network with one receiver



. . . Collins FA-201

The new Collins FA-201 fault reporting system not only monitors a microwave network . . . it remembers what it learned for later recall.

Using a sequential technique, the system monitors up to 16 remote stations. And it reports on either 16 or 32 functions per station.

A remote station transmits a data stream containing information on 16 functions every half-second (every second for the 32-function option). The master station compares the data stream at the same rate with information in memory.

If a fault exists, the deviation is lodged in the memory unit and an audible alarm sounds. The operator simply notes on a bank of status indicator lamps which station has reported the error. He then interrogates the receiver memory to identify the fault.

The all-solid-state design and subsystem packaging of the FA-201 greatly reduce maintenance procedures; plug-in integrated circuits accelerate repairs and minimize downtime.

The FA-201 is another example of engineering and manufacturing excellence achieved at Collins through use of the C-System, an integrated, computer-controlled system for design and production.

For complete information on Collins new monitor with a memory, write Collins Radio Company, Dept. 400, Dallas, Texas 75207. Phone: (214) 235-9511.

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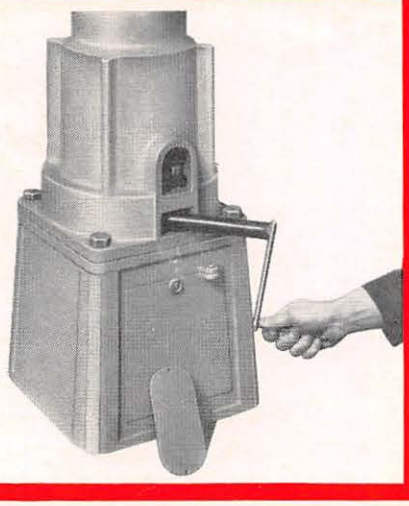

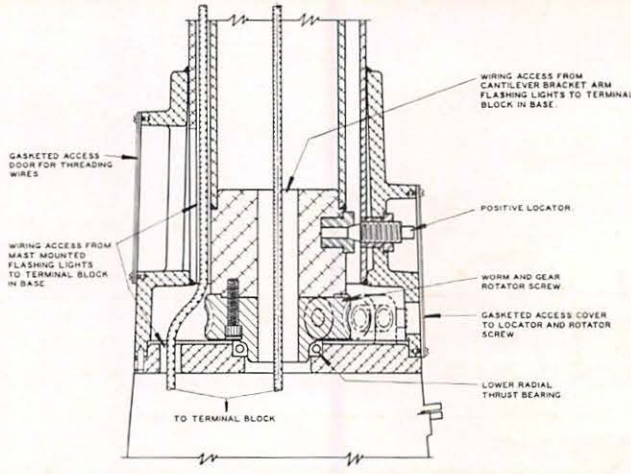
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POSITIVE LOCATOR
WIRING ACCESS FROM MAST MOUNTED FLASHING LIGHTS TO TERMINAL BLOCK IN BASE
WORM AND GEAR ROTATOR SCREW
GASKETED ACCESS COVER TO LOCATOR AND ROTATOR SCREW
LOWER RADIAL THRUST BEARING
TO TERMINAL BLOCK

SIMPLY, IT'S A TURN FOR THE BETTER. In servicing, the bracket-arm of the Western-Cullen Rotatable Aluminum Cantilever Type A760 is released and revolved off-the-highway from the base. Not from the top. Both operations are done simply with a crank. Climbing is required only in servicing the lights.*

Then, when servicing is completed, the arm is cranked back to its over-the-highway position. Then locked. All from the ground, at the base.

Of course, being a "pro," you know all the other features of Western-Cullen's Type A760 Cantilever:

• Withstands 100 MPH wind pressure • When bracket arm is off-highway, it sets automatically in a fixed position for servicing • Available with 12, 15 or 20 foot bracket arms, with 17 foot road clearance • Light-in-weight; your shipping cost is less • Obviously, it's easier to install and maintain • Naturally, being aluminum, it requires no painting and is corrosion resistant.

Truly, you're doing yourself a good turn when you choose the new W-C Rotatable Aluminum Cantilever Type A760!

*Aluminum hook-on ladder available

More information?
Write to us for additional data:

WC WESTERN-CULLEN DIVISION

FEDERAL SIGN AND SIGNAL CORPORATION

Call Us "THE FUTURISTS" (It's a Name We Enjoy Living Up To!)

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